REVIEW

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A systematic review of the impact of ICT on literacy learning in English of learners between 5 and 16, for whom English is a second or additional language

Review conducted by the English Review Group

The EPPI-Centre is part of the Social Science Research Unit, Institute of Education, University of London

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LIST OF ABBREVIATIONS

BECTa	British Education Communications and Technology Agency
CALL	Computer-assisted language learning
EAL	English as an additional language
EFL	English as a foreign language
ESL	English as a second language
ESOL	English for speakers of other languages
ICT	Information and communication technology
L1	First/mother/home language
L2	Second/later acquired language
RCT	Randomised controlled trial
REEL	Research Evidence in Education Library
SEN	Special educational needs

NOTE ON TERMINOLOGY

The terminology used in the review to describe learners' characteristics is the original terminology used by the authors of the included studies (e.g. 'mildly mentally handicapped', etc.). Such terminology has been included in quotation marks to indicate direct quotation from the original studies.

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SUMMARY

General background

The English Review Group completed an overarching systematic review of the impact of Information and Communication Technology (ICT) on literacy learning in English in 2002 (Andrews *et al.*, 2002). In that review, a descriptive map described all the included research in the field. An in-depth sub-review reported on the impact of networked ICT on literacy learning (Andrews *et al.*, 2002). This review is one of a further four in-depth sub-reviews that address aspects of the overarching question – what is the impact of ICT on literacy learning in English? The broad background to the descriptive map and the in-depth sub-reviews is that there is a growing concern internationally that the investment in ICT in schools is not impacting on literacy development. This concern arises from a belief held by many – including governments as well as schools – that ICT *is* beneficial to learning and specifically literacy learning. The question is a specific one and has to be seen within a wider political, social and technological context, in which the symbiosis between new technologies and new literacies (and thus literacy learning) is acknowledged.

This review addresses a question about the impact of ICT on literacy learning for one particular group of learners.

Background to this review

Governments naturally tend to frame educational policy primarily in terms of learners who have reasonable mastery over the language(s) of instruction. It is therefore of considerable importance to examine the needs of groups who do not have such mastery. This in-depth review focuses on one such group: learners for whom English is a second or additional language (ESL/EAL). Several countries, including the UK, have begun to develop national programmes and guidelines for ESL/EAL students, and the result is a major commitment of educational resources, in terms of people and, potentially at least, in terms of financial investment. These factors make it particularly important that the programmes and guidelines should be, wherever possible, supported by the findings of high quality research.

Computers are playing an increasingly pervasive part in almost all aspects of people's lives, including the ways in which knowledge and skills are acquired. Information is easily accessible on the internet in many languages and computers seem destined to play a crucial role in supporting or supplying language training for a range of different age groups. Existing language teaching methods were largely designed to optimise face-to-face teaching and it is not inherently obvious which methods will work in a computerised environment and which will not. Developing computer-based courses is also highly time-consuming and this can prove expensive, simply in terms of the hours involved. So, as research on different forms of e-learning or Computer-Assisted Language Learning (CALL) begins to accumulate, it is extremely important, for the development of methodology as well as the making of language learning policy by education

authorities, to establish just what principles or methods can be derived with confidence from published studies.

Given the interest in computers and the availability of so much material in different languages, it is perhaps surprising that reviewers have in fact been less than positive about the results of research into CALL. In 1990, Carol Chapelle, for example, seriously questioned the validity of many current CALL research studies, pointing out instead the crucial importance of the classroom. Hyland (1993) added a series of propositions about factors likely to be crucial to effective CALL learning. The Chapelle and Hyland studies only serve to emphasise the need for a systematic review of the field and the two studies act as a useful backdrop to the present review.

Aims

The overall aim of the two-year project is to determine the impact of ICT on literacy learning in English for 5-16 year-olds.

The aim of this particular review is to examine written literacy-related ICT research studies from 1990 onwards, with respect to their impact on ESL/EAL students and (where possible) their teaching/learning environment.

Review questions

The overall research question for the two-year project is 'What is the impact of ICT on literacy learning in English, 5 – 16?'

The research questions for this review are:

What is the evidence with respect to the impact of ICT on literacy learning in English of learners between 5 and 16, for whom English is a second language (ESL) or an additional language (EAL)?

and

What conclusions may be drawn with reasonable confidence from the evidence?

Methods

Defining relevant studies for the descriptive map of the overarching review: inclusion and exclusion criteria

The earlier systematic review (Andrews *et al.*, 2002) mapped the research on the impact of ICT on literacy learning in English, 5-16. The relevant research was searched for, located, sent for and mapped for the years 1990-2001. In addition to updating the searches for the period 2001-2002 and screening for inclusion of any potentially relevant studies for the period 2001-2002, all the included studies in the original map were re-keyworded, using revised generic and review-specific keywording sheets. The English Review Group working document (Appendix 2.1) for the inclusion and exclusion of potentially relevant studies was updated to

reflect changes made to the keywording sheets, both generic and review-specific. See Appendix 2.1 for the inclusion/exclusion criteria for the descriptive map of the overarching review.

Defining relevant studies for the in-depth review: inclusion and exclusion criteria

Studies were identified on the basis of the keywords ESL and EAL, re-screened with respect to whether they matched the inclusion and exclusion criteria, and the resulting papers were data-extracted by both authors. The procedure was checked by a moderator, who also data-extracted two studies.

Results

Identification of studies: the descriptive map of the overarching review

A total of 2,319 potentially relevant reports were identified for the current review. Of these 2,319 reports, 1,891 (just over 81%) were excluded by screening titles and/or abstracts and 428 were sent for. Of the 428 reports, 34 (fewer than 8%) 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 182 reports, leaving a total of 212 that met the criteria for inclusion in the mapping study.

Identification of studies: in-depth review

Eight studies were included in the in-depth review: four at primary-school level and four at secondary. Three studies were considered to have a 'medium' weight of evidence for the review and the remainder were low. The reasons for this varied from uncertainty about classification, to methodological and analysis problems. The main result was that it was impossible to find a clear impact pattern. There was some evidence that, under certain conditions, word-processing could improve writing and editing quality. There was a general trend towards students finding computer-assisted sessions enjoyable and helpful, and teachers reported their role changing towards being facilitators. There were some suggestions that integration into regular class procedures and activities, a high-support user-friendly environment and the use of collaborative work with the goal of a concrete end-product aids learning and motivation, but the evidence was not clear-cut or conclusive.

Conclusions: in-depth review

The main strength of this in-depth review is that the reviewers were able to work from an applied linguistic viewpoint, which considers psychological and social variants as relevant to language teaching and learning. The major limitations are that (a) the in-depth review is small, (b) the included studies gave little information about classroom practices or aspects of bilingualism and (c) the studies tend to date from the early 1990s, and thus do not deal with modern hardware or internet-based teaching and learning.

The major conclusion is that not enough can be concluded from the studies examined to support policy decisions about increasing the role of computers in language education. Essentially, much more research is needed and research

should take classrooms and details of the bilingualism and bilingual education involved far more seriously.

Specifically, a number of robust studies are needed to address the research question. These should systematically record, monitor and investigate:

- learners' ethnicity and existing level of proficiency in English;
- the learning processes which particular items of ESL/EAL software engender;
- the relationship between those processes and the learning processes of the mainstream classroom and the culture at large;
- learning gains and attitude changes;
- these and other outcomes of the ESL/EAL ICT-based learning programmes compared with those of other forms of ESL/EAL learning programmes.

1. BACKGROUND

1.1 General aims and rationale

The impact of Information and Communication Technology (ICT) on literacy learning in English is a topical and important issue. There is a need for a systematic review 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.

Between March 2001 and June 2002, the English Review Group carried out the first part of a systematic review in attempting to answer the overall question 'What is the impact of ICT on literacy learning in English, 5-16?'. Having mapped the research literature, the first in-depth review focused on networked ICT (i.e. email and the internet). The second part takes the form of another in-depth (sub-) review that investigates four aspects of the impact of ICT on literacy learning: effectiveness as determined by randomised controlled trials; ICT and 'moving image' research; literature-based literacies; and the impact on ESL/EAL learners. It is this last topic that is the subject of the present review.

1.2 Aims and rationale for current review

There is now a very large number of computer-based teaching materials, articles and books advising teachers on how to make productive use of ICT with students who are attempting to acquire a second or foreign language. As Chapelle (1990, p 199) puts it, 'Computer-assisted language learning is now used routinely in language instruction'. At a general policy level, the UK government has justified its investment in ICT in schools in terms of its positive impact, citing five research reports from the British Educational Communications and Technology Agency (BECTa 1998; 1998-99; 2001a; 2001b; 2001c). While there are numerous anecdotal eulogies of the role of computer-assisted learning in language and literacy situations, it remains unclear whether there is well-researched evidence of a positive impact. Chapelle's stark comment from her 1990 paper on research studies (in EFL as well as ESL/EAL) published before 1990 establishes that there is a serious need for a detailed review of research conducted post-1990:

> 'Little if any current CALL research can offer unambiguous evidence concerning effects of CALL activities because current research methods fail to elucidate exactly what students do while they work with language learning software' (Chapelle, 1990, p 200).

Similar caution is expressed by Hyland (1993) on the more specific topic of word-processors. Hyland briefly compared positive, negative and unclear research findings up to 1991 and concluded that, 'Research is unable to confirm that the quality of computer written texts is superior to conventionally produced work', although 'studies of motivational and attitudinal changes… tend to be more positive' (p 22). Hyland was writing with respect to EFL rather than ESL/EAL students, but his conclusion about the importance of teaching/learning support and its methodology (allied to collaborative learning and integration with the

regular curriculum), resembles that of Chapelle and should be taken to imply a major line of approach in any review of ESL/EAL-related ICT research in the 1990s and after: 'There is little doubt that support is a critical variable in this process. Quite simply, the most convincing improvements in student writing are not due to computers, but teachers' (p 28).

Chapelle was particularly concerned with the need to describe interaction accurately, but her finding that little unambiguous evidence exists regarding CALL effects introduces a possible worry that other areas of research methodology might be equally problematic. A systematic review of studies in the last decade of the twentieth century and the start of the twenty-first was thus felt to be needed. The present review restricts Chapelle's focus in two ways: firstly, it treats only research on written literacy; and secondly, it considers only learners who are acquiring English as a second (rather than a foreign) language. The reason for this latter restriction is primarily due to the very different social, psychological and learning situations between foreign language and second language learners. Foreign language learners are rarely surrounded by the target language culture outside the classroom and are not in most cases attempting to balance their personalities between a world of school and work which expects an understanding and acceptance of English and the supportive world of parents and relatives which gives them their identity and heritage. There are some similarities in the methods used to teach EFL and ESL/EAL learners, but there are inevitably great differences in the needs and interests of the learners, the learning environment, the content of the courses and the methods adopted. It is for these reasons that we have taken the view that the EFL literature really requires a separate review.

The general approach taken here may be broadly defined as 'applied linguistic'. By this, we simply mean that psychological, social and cultural variables (and relationships) are considered to be as relevant to language teaching and learning as methodological and linguistic ones.

1.3 Definitional and conceptual issues

There are several terms that require defining for the purposes of the review and these are linked to conceptual issues connected particularly with aspects of bilingualism.

1.3.1 ESL/EAL

The expression 'English as an additional language' (EAL) tends to be used as a cover term when it is unclear whether one is considering English as a Foreign Language (EFL) or English as a Second Language (ESL) (Görlach, 2002). EAL has relatively recently been adopted for general use by the Department for Education and Skills (DfES) in England to apply as a general term to ethnic minority learners. EAL is thus useful for the present study as a search term, as long as a secondary check is made to eliminate EFL situations.

The term **'**English as a second language' (ESL) is far more common in the literature on language learning than EAL, and as such needs to be treated as the main keyword in this review. The term is, however, used variably in the research and teaching literature. It is often used, for example, within sociolinguistics to refer to English in former colonies, where there was a small native English-

speaking group of administrators, and English was a, or the, official administrative language, but there was little use of English in the general community (Görlach, 2002). This is not the sense in which ESL/EAL will be used in this report. It is used here in the sense in which it is commonly employed in UK educational circles, namely to refer to students in the education system of a largely English-speaking host culture, and who, in theory, are immersed in that culture and environment. This latter view has pedagogical implications, as one might expect issues of cultural identification and assimilation (or rejection) to be taught rather differently in EFL and ESL/EAL situations.

The above characterisation of ESL/EAL also has implications identification of studies for the review. While it is relatively easy to isolate ESL/EAL students in schools in the UK, US, Australia, Canada and New Zealand, it becomes correspondingly harder to categorise students in English-speaking schools in say, Hong Kong, India, Holland, or Uganda, where English is an official language, but the bulk of the population cannot be said to be immersed outside school in a rich English-speaking culture. Even in the 'English-speaking' countries, it is not always uncontroversial how to categorise particular groups. Refugees, for example, represent a border category between a second and a foreign language; if they were isolated from the host culture, then they would be treated as EFL, but if they were allowed to live relatively freely in the host culture they would be effectively ESL/EAL. The children of second or third generation immigrants are likely to have adapted more to the host country and its language, but it does not necessarily follow that their English is of high proficiency and that they should not be categorisable (for some purposes at any rate) as ESL/EAL. Black, Caribbean or African-American students in the US represent a different categorisation problem. The linguistic literature is divided about whether 'Black English Variety' (so-called BEV) should be treated as a dialect of standard English (arguing for categorisation as native speakers) or as a Creole approaching standard English (arguing for categorisation as ESL/EAL). It was decided that speakers of BEV would be categorised for this report as native speakers, thus differentiating them from, say, Hispanic students in the US, who would, if their command of standard English was reasonably low, be categorised as ESL/EAL. Indigenous groups, such as the Maoris in New Zealand, whose settlement in the area predates that of the dominant English-speaking group, represent yet another categorisation problem. If their linguistic situation is such that their command of English is relatively poor and they are not free agents in the economy (e.g. the job market), then they are categorised as ESL/EAL. The effect here, as with Hispanic students in the US, is that some Maori students must be treated as native speakers, while others might be reasonably categorisable as ESL/EAL.

In short, an ESL/EAL situation is hard to define, but may be characterised prototypically as one where English is (a) not the primary language of the learner or the home, but is (b) the current medium of instruction, (c) the language of the wider community and (d) an official language at national level. It needs to be stressed that US researchers sometimes use ESL/EAL to refer to what UK researchers call EFL; this means that, for this review, the reviewers need to re-screen studies to remove ones which are actually EFL-oriented.

It is worth noting, however, that the UK government has recently elected to use the acronym ESOL in place of ESL/EAL. This represents an interesting broadening of the spectrum, as English for Speakers of Other Languages places no ordinal meaning upon any language.

Although this study used ESL and EAL as the main keywords, future updates will also use ESOL. For the sake of readability, ESL, as the more common of the two acronyms, will be used from this point on to mean ESL/EAL.

1.3.2 Bilingualism

Categorisation as ESL implies a philosophical position on the notion of bilingualism. This, like ESL, is variably treated in the literature. If ESL groups are partly characterised by a less than 'perfect' command of English, and an imbalance between their languages, then the only appropriate view of bilingualism is a so-called 'inclusive' view whereby bilingualism is relative, not absolute, or balanced. Establishing a minimum cut-off point remains controversial, however (Baker, 2001), and somewhat subjective. For the present review, any second language knowledge over zero will be treated as evidence of bilingualism.

1.3.3 Types of bilingualism

Research suggests that students who choose to learn a second language (L2) can show greater gains than those who are forced to learn it (Baker, 2001) and that those who see the L2 as adding to their repertoire make more progress than those who see it 'subtractively', as involving a loss of their first/mother/home language (L1) and/or home culture (Baker, 2001; Ellis, 1985). Again, students who live in a situation in which it is expected that everyone will acquire the nation's languages (individual bilingualism) may well progress differently from students in situations in which there are different language groups, but these remain relatively monolingual; that is, there is social, but not individual bilingualism (see Fasold, 1984; Gardner, 2002; Romaine, 1995). It is highly likely that the use of ICT in formal (or even informal) educational situations will be affected by the ways in which the students concerned perceive the nature of their bilingualism. Although the keywording system (described below) did not take features of bilingual situations into account, the reviewers felt that it would be important to note all such detail mentioned in the included studies.

1.3.4 Impact

We have preferred to review studies for evidence of 'impact' rather than 'effect', because it tends to be generally understood in a broader way in the context of research studies (see Andrews *at al.*, 2002; Coles, 2002). We have avoided the term 'outcomes' in the title simply because the word is often used in both a narrow and a broad sense. For present purposes, 'impact' may be defined in a global way as 'the totality of change, or altered capacity for change, in people or processes related to those involved in the research'. Thus outcomes, whether 'immediate/long-term' or 'direct/indirect', contribute to such change or capacity for change. Moreover, while 'effects' tend to be local, specific and measurable (whence indices such as effect size), the 'impact' of a literacy programme might be felt in various ways by parents, employers and school administrators as well as the learners. Moreover, it might also be delayed, involve paths through life that might not have been selected otherwise, or serve to reduce attitudes to seemingly unrelated entities. Although few of these broader issues were in fact addressed by most of the studies included in the review, the object was to establish a framework broad enough to discuss them, if the opportunity arose.

1.4 Policy and practice background

The present review examines research studies produced from 1990. The feeling then was one of excitement that computers were starting to show their value and had great potential. As Huss *et al*. noted in the 1990 Eric digest 'Using computers with adult ESL literacy learners':

> 'The prospects for using computer-assisted instructional programs and other technological media with adult ESL literacy learners are excellent, provided that programs are designed or adapted especially for these learners and that instructors are willing to try new and innovative approaches' (Huss *et al.*, 1990).

The comment is equally applicable to learners aged between 5 and 16.

Since around the middle of the 1990s, there has been a vast and worldwide explosion of educational use of interactive technologies, centred around the internet, and even a basic web search will now bring up hundreds of teacher-oriented and materials-oriented websites for use with EFL and ESL students. For all practical purposes, the assumption now made is that CALL materials are here to stay and that their value is self-evidently positive. However, few of the sites seen by the present reviewers are concerned with evaluating usefulness in a systematic way. There is therefore an increasing need for research studies which explore impact and effectiveness with rigour and non-commercial objectivity.

Along with the explosion of websites and internet use is the increase in powerful, fast multimedia computers, often networked within a school or college. As Levy (1997) put it:

> 'The convergence of once separate media such as video and the computer, or telecommunications technologies and the computer, moves us towards a multi-user, multi-site environment for interaction and learning, stretching far beyond the confines of the traditional computer laboratory' (Levy, 1997, p 44).

While these facilities have been enthusiastically received by EFL teachers and huge international link-up networks, such as Ruth Vilmi's 'International Writing Exchange' (Vilmi, 2000) have been created, it is less clear how far ESL students (in the sense defined here) have benefited from increased hardware and access to it. Thus, for example, the 2002 study by the UK's Basic Skills Agency, 'A case for change: how refugee children are missing out' notes in general that including refugee children in mainstream classes 'can present a substantial challenge' (p 8), but does not consider ICT questions in any detail.

As with many language education situations, it is hard to estimate just how many ESOL learners there are; the DfES (2003), in April 2003, reported 659,000 in England alone. From a world perspective, this is clearly far smaller than the millions of EFL learners, but the numbers are sufficiently large for schools to feel hard pressed and to need help. To this end, the UK government has created BECTa, the British Educational Communications and Technology Agency, which maintains an educational software database with a language learning component plus advice pages to community language teachers on how to use ICT. With increased government interest and funds being made available to evaluate basic skills training, this is perhaps an appropriate time to have a review of empirical research on the impact of ICT.

Readers may well be aware of the government drive within England, begun in September 1998 and known as the National Literacy Strategy (NLS), that is aimed at raising standards of reading and writing among primary school pupils. Since September 2001, the NLS's focus has expanded to encompass 11 to 14 year-olds under the Key Stage 3 Strategy. A prominent feature of both strategies is the production of large amounts of teacher resources and guidance documents. One strand of these focuses directly upon teaching EAL pupils. However, CALL does not yet figure in DfES' key EAL materials published so far, in 2001 and 2002. The present review may assist classroom teachers in primary and secondary schools across England in selecting teaching programmes for their classes with EAL children.

1.5 Research background

A study from the first year of the current project (Andrews *et al.*, 2002) – a mapping exercise on the impact of ICT on literacy learning and an in-depth review of the impact of *networked* ICT on literacy for 5 to 16 year-olds – identified 188 papers published since 1990 that examine the impact of ICT. Most of these originated from the US, although a significant minority arose from research in the UK, Canada, Australia and New Zealand. Of the total, 67 percent were set in primary/elementary schools (especially in the 7 to 11 age range), with about 44 percent set in secondary/high schools; some studies were conducted in both types of setting. About two-thirds of the studies assumed a psychological representation of literacy: that is, they assumed that literacy development was an individual matter concerned with writing and reading processes. One-third adopted 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 percent were focused on writing, graphical or pictorial production, whereas 46 percent had an interest in reading.

Andrews *et al*. (2002) found that there are a number of studies relating to ESL learners and, more importantly, that published literacy studies do indeed show a range of methodological problems. The data from the Andrews *et al*. study suggested that few ESL studies took the rigorous form of a randomised controlled trial (RCT) and the comments by Chapelle (1990) further suggested that the RCT format might be difficult to implement, if detailed interaction data were needed. It was accordingly realised that RCTs might well not be very common, and it was decided to broaden the review to evaluation studies, which relied on a rigorous analysis of empirical data.

1.6 Authors, funders and other users of the review

Richard Andrews is the Co-Ordinator of the English Review Group. His immediate team consists of Carole Torgerson (Research Fellow at the University of York) and Alison Robinson (Research Secretary for the Review Group), Sue Beverton (University of Durham), Jenny Leach (Open University), Andrew Burn (Institute of Education), Graham Low (Language Teaching Centre, University of York), Terry Locke (University of Waikato, New Zealand) and Die Zhu (University of York), who each took responsibility for sub-reviews; they also read interim drafts, attended training and acted as a project team in the creation of the review. During the mapping exercise, Torgerson managed/administered the process, with team members contributing. During the writing-up of the review – undertaken on

two levels: the writing-up of the overall descriptive map of the overarching review, co-ordinated by Torgerson, Robinson and Andrews, and the composition of chapters for the RoutledgeFalmer book, co-ordinated by Andrews[1]) – team members played a more individual role, while maintaining the collective critical eye on the development of the material.

Reference was made to our international colleagues, Wendy Morgan and Eileen Shakespeare. Nancy Rowland advised from a NHS CRD perspective; Diana Elbourne and Katy Sutcliffe from the EPPI-Centre acted as independent reviewers for sets of the abstracts and sample papers at the mapping, keywording and the data-extraction stages, using the review's final set of criteria.

The English Review Group also consists of Nick McGuinn (University of York), Maggie Snowling and Peter Hatcher (both Department of Psychology, University of York), James Durran (Parkside Community College, Cambridge) and Gloria Reid (City of Kingston-upon-Hull Education Services). More achieved drafts of the emerging review – and any other questions that arose in the process of reviewing and writing – were presented to this advisory group, both at and between formal English Review Group meetings. The advisory group contains members representing 'user groups': for example, Gloria Reid for primary schooling and the education advisory services, James Durran from secondary schooling, and Nancy Rowland as parent governor of both a primary and secondary school[2].

In our first in-depth review, users were involved in determining the topic to review, commenting on the protocol, commenting on drafts of the report, disseminating the results of the review (most notably at the launch of the first reports in June 2002) and in writing user summaries. In this present in-depth review, such involvement has continued. To summarise further action:

- Users on the advisory group have commented, and will continue to do so, on the emerging sub-review.
- They will take a more proactive role in disseminating the results of the review.
- Discussion of the draft conclusions and of the methodology of the review took place with senior figures at the Teacher Training Agency in a meeting in York in June 2003.
- We will hold a meeting early in 2004 with teachers, parent governors, LEA advisers and others to disseminate the findings of the review and to receive critical feedback.
- Students in initial teacher education will be invited to our dissemination meeting to provide critical feedback.

User summaries will be commissioned once the review is completed. These will be from a policy-maker, parent governor, teacher and students, as in the first review. These summaries will be published on REEL, disseminated at conferences and through the communication networks of the different constituencies (e.g. governors' newsletters).

1 RoutledgeFalmer have commissioned a book from the Review Group, edited by Andrews with contributions by Beverton, Burn, Die, Elbourne, Leach, Locke, Low, Rees and Torgerson. The book, *The Impact on ICT on Literacy Education*, was submitted in July 2003 and will be published in 2004.

2 Almost all members of the advisory group are parents of school-age children.

1.7 Review questions

The research questions for this review are:

What is the evidence with respect to the impact of ICT on literacy learning in English of learners between 5 and 16, for whom English is a second language (ESL) or an additional language (EAL)?

and

What conclusions may be drawn with reasonable confidence from the evidence?

1.8 Structure of the review

The review is structured as follows:

In the **descriptive map of the overarching review**, the process of identifying, including and characterising the studies for the systematic review of the *impact* of the ICT on literacy learning is described. This overall descriptive map is followed by an **in-depth effectiveness review** for ESL studies

2. METHODS USED IN THE REVIEW

2.1 User involvement

User involvement took place throughout the process of systematic reviewing in the following ways. First, the English Review Group's advisory group determined the topic for the review; second, it commented on the draft protocol; third, it commented on the map of studies, advising which particular sub-areas of ICT and literacy were most appropriate for in-depth review; and fourth, it commented in the draft in-depth review report.

A group of students, teachers, LEA advisory teachers, parents, researchers and governors will be invited to a colloquium to discuss the final draft of the report as part of a dissemination strategy.

A dissemination strategy for the project as a whole was developed in consultation with the parent governor/Director of Dissemination for NHS CRD.

2.2 Identifying and describing studies

2.2.1 Defining relevant studies for the descriptive map of the overarching review: inclusion and exclusion criteria

In order to be included in the mapping section, studies had to meet the following inclusion criteria:

- They had to be one of the following study types: an exploration of relationships, an evaluation (naturally-occurring or researcher-manipulated) or a systematic review.
- They had to have as their main focus ICT applications to literacy development.
- They had to focus on literacy learning and teaching in schools and/or homes.
- They had to be about the impact of ICT on literacy development.
- They had to be published in English, in the period 1990-2002.
- They had to look at literacy and ICT in English-speaking countries.
- They had to be completed studies.
- They had to be studies whose participants/study population includes children aged 5 to 16 and young people.
- They were not to be opinion pieces or studies of other excluded study types.

The English Review Group working document for the inclusion and exclusion of potentially relevant studies (see Appendix 2.1) was updated to reflect the changes made to the keywording sheets, both generic and review-specific (see appendices 2.4 and 2.5) since the 2000-2002 review. In terms of the generic keywording sheet the main differences for 2002-2003 are the changes made to question 10 on study type. In terms of the review-specific keywording sheet, the main differences for 2002-2003 are the streamlining of the literacy, learning and ICT focus keywords (question 12), and the inclusion of a glossary sheet to clarify definitions for all the review-specific keywords (see Appendix 2.6).

2.2.2 Defining relevant studies for the in-depth review: inclusion and exclusion criteria

The present study draws on the earlier study by Andrews *et al.* (2002) and attempts to build on it by adding more recent relevant studies. The high incidence of anecdotal studies or teacher support papers known to be in the literature made it important to find an appropriate division between studies involving rigorous data- collection and analysis (to be included) and studies not doing so (to be excluded). Without a focus on a particular research methodology, however, the task of drawing a line between the two retains a degree of subjectivity. In the event, it was decided that, to be included, a study would have to be based on a clear body of empirical data, which the authors had collected in a systematic way, and retained for examination and analysis. Studies which had no obvious data, or which were based on very subjective and/or inconsistent field coding, would not be included. Similarly, case studies which examined just one student or unit would not be included if they were purely descriptive. If an intervention was involved (and analysed), however, then the study would be included.

2.2.3 Identification of potential studies for the descriptive map of the overarching review: search strategy

The potential studies for this review were identified through an updating of the original electronic searches and handsearches. In August 2002, Julie Glanville (NHS CRD at the University of York) re-ran the electronic searches on PsycINFO, ERIC, BEI, SSCI, SIGLE, C2-SPECTR and Dissertation Abstracts using the original search strategies (see Appendix 2.2). In addition, members of the Review Team and Advisory Body who handsearched key journals in the field for the 2001-2002 review undertook handsearching of the same journals for the period July 2001 to October 2002 in order to identify any other potentially relevant studies not retrieved through the updated electronic searches (see Appendix 2.3). All potentially relevant studies were sent for.

2.2.4 Identification of potential studies for the in-depth review: search strategy

For the present review, the database was updated for studies after 2000 and re-keyworded (using EPPI-Centre, 2002a). The keywords ‘ESL’ and ‘EAL’ were applied to identify studies for the present review.

2.2.5 Screening studies: applying inclusion and exclusion criteria

All studies which resulted from the initial ESL keywording were re-screened to check that they matched the characterisation of ESL (above) and met the other inclusion criteria. Two studies failed to meet the criteria, but the remainder were included in the in-depth study.

2.2.6 Screening studies for the descriptive map of the overarching review: applying inclusion and exclusion criteria

The updated database for 2002-2003 that included potentially relevant studies published after October 2001 was screened by a member of the review team (CT), using titles and abstracts and the updated working document with inclusion and exclusion criteria. Any potentially relevant studies were sent for through library interlending. Finally, the original database was merged with the updated database.

2.2.7 Characterising included studies in the descriptive map of the overarching review: EPPI-Centre and review-specific keywording

All the studies included in the original database from the review of 2001 were re-keyworded by members of the Review Team using the new guidelines from the EPPI-Centre (EPPI-Centre, 2002a). The studies retrieved for the updated database were keyworded by a member of the Review Team (CT), with assistance from other members of the Review Team and the EPPI-Centre where there was any doubt about keywording. The database was fully annotated with the keywords (AR). For pragmatic reasons, the database for 2002 was closed on 30 November 2002. Any studies received after that time will be included in the next update.

2.2.8 Characterising included studies in the in-depth study: EPPI-Centre and review-specific keywording

The included studies were characterised using the EPPI-Centre and review-specific keywords (see Appendix 4.1).

2.2.9 Identifying and describing studies in the descriptive map of the overarching review: quality assurance process

For the purposes of quality assurance, two members of the Review Team (RA and SB) and one member of the EPPI-Centre (DE) screened a random sample of 10 percent of the studies in the updated database. Screening was undertaken independently, using the inclusion/exclusion criteria working document (Appendix 2.1). After double-screening, the inter-rater reliability scores between CT and RA, CT and SB, and CT and DE were calculated using Cohen's Kappa. For the purposes of quality appraisal, a random sample of 18 papers was double re-keyworded by two members of the EPPI-Centre (DE and KS).

2.2.10 Identifying and describing studies in the in-depth review: quality assurance process

Two reviewers (GL and SB), or one reviewer and the moderator (GL and CT), independently re-screened the studies retrieved from the database and then compared results. There were no disagreements that required EPPI-Centre advice or mediation.

2.3 In-depth review

2.3.1 Overview

For a paper to be included in the in-depth review, it had to be a study looking at the impact of ICT on the teaching and/or learning of (written) literacy to children in a school or school-related setting. After-school activities organised by, say, a local community centre, would be acceptable if the other criteria were met. The teaching/learning situation had to be characterisable as ESL. In practice, this was taken to mean that the language of instruction should be primarily English, and this applied to the teacher(s) as well as the language output by the computer program. The teaching/learning needed to take place within an English-speaking environment, although it was accepted that the learner's homes or the immediate local community might well be L2-speaking.

A number of methodological constraints were also needed. Research studies were only included where they identified and reported separately on ESL students. This had originally been envisaged as a totally unproblematic condition, which was not important enough to add to the list of review-specific conditions in the protocol. In practice, however, it proved to be a serious problem, such that studies had to be included, but their quality was severely reduced due to failure to discuss or report ESL issues in an adequate way. A second constraint related to the need to review only genuinely empirical studies. This implied that there needed to be actual data which had been gathered in a systematic way and which could be subjected to analysis at one or more stages after the collection period. The data also needed to be sufficiently comprehensive that general statements could be made and justified. Where the data were selective or non-systematically collected (implying that no analysis was possible and only anecdotes or illustrations could be reported), a study was not included. The same applied to studies which relied heavily, or totally, on on-site field coding, such that either the result was felt to be over-subjective, or no real analysis was possible. Thirdly, a position needed to be taken on case studies. A purely descriptive case study can be academically invaluable, as with Halliday's classic study (1975) of the (first) language development of his son. An impact study, however, requires some evidence (and analysis) comparing before ICT with after ICT, or with ICT versus without ICT, so, for this review, only studies involving what could be categorised as an 'intervention' were included.

A summary of inclusion and exclusion criteria for the in-depth review is given below.

Inclusion criteria

- They must involve children between 5 and 16 years old.
- They must involve/report on a research study of a written literacy-based intervention (reading, writing or spelling).
- They must collect and analyse a defined body of empirical data.
- They must report on progress (process, product or both) of ESL learners.
- The language of instruction must be English (or primarily English).
- The language of the wider community (or a large part of it) must be English.
- English must be the (or an) official language.

Exclusion criteria

- The studies are not research studies.
- There is no literacy-related intervention.
- The learners are not of the wrong or indeterminate age.
- There is no body of empirical data or systematic analysis.
- The learners are not ESL.

2.3.2 Detailed description of studies in the in-depth review: EPPI-Centre and review-specific data-extraction

With two exceptions, all studies were double data-extracted by the two authors (GL and SB). The exceptions were double data-extracted by GL and the moderator CT. One of the studies was an RCT which also features in the RCT report by Torgerson and Zhu; the summaries are almost identical except for comments relating to bilingualism. Data-extraction was undertaken using the EPPI-Centre Guidelines (EPPI-Centre, 2002b). Any disagreements were resolved by discussion between the reviewers; any remaining coding or categorisation problems were referred to the moderator (CT), or the EPPI-Centre.

2.3.3 Assessing quality of studies and weight of evidence for the review question

The EPPI guidelines were used to assess the quality and trustworthiness of the findings and conclusions at a general level. In addition, the new review-specific 'weight of evidence' summaries were employed.

2.3.4 Synthesis of evidence

The variety of methods used to undertake the included studies, plus variations in the detail in the reports meant that it was not possible to reanalyse studies, or to create a common index for comparison (such as 'effect size'). The evidence from the review is thus reported verbally in 'narrative' form.

2.3.5 In-depth review: quality assurance process

Any cases of studies being excluded (plus the basis for their exclusion) were to be discussed by reviewers and the moderator, with the decision to exclude to be made only after detailed checking against criteria and with agreement by all parties.

3. IDENTIFYING AND DESCRIBING STUDIES: RESULTS

3.1 Studies included in descriptive map of overarching review from searching and screening

Table 3.1 illustrates the process of identifying, obtaining and describing reports for the current review. Unless otherwise stated, each report contains only one study[1].

A revised version of the mapping study retrieval process reported in Andrews *et al.* (2002) is shown in column 1. The revisions were the result of further de-duplication of the database (four papers deleted), annotation of reports received outside the review's original timeframe (n = 8), and re-keywording of included reports in accordance with EPPI's revised Guidelines (EPPI-Centre, 2002a), which led to further exclusions (n = 8). In addition, five papers originally excluded at the second stage were included in the current review following re-keywording. Column 2 shows the mapping study retrieval process for those additional reports identified by an update of the electronic and handsearches. The final column merges the original mapping study retrieval process with the update to show the process of retrieval of the reports in the mapping study for the current review.

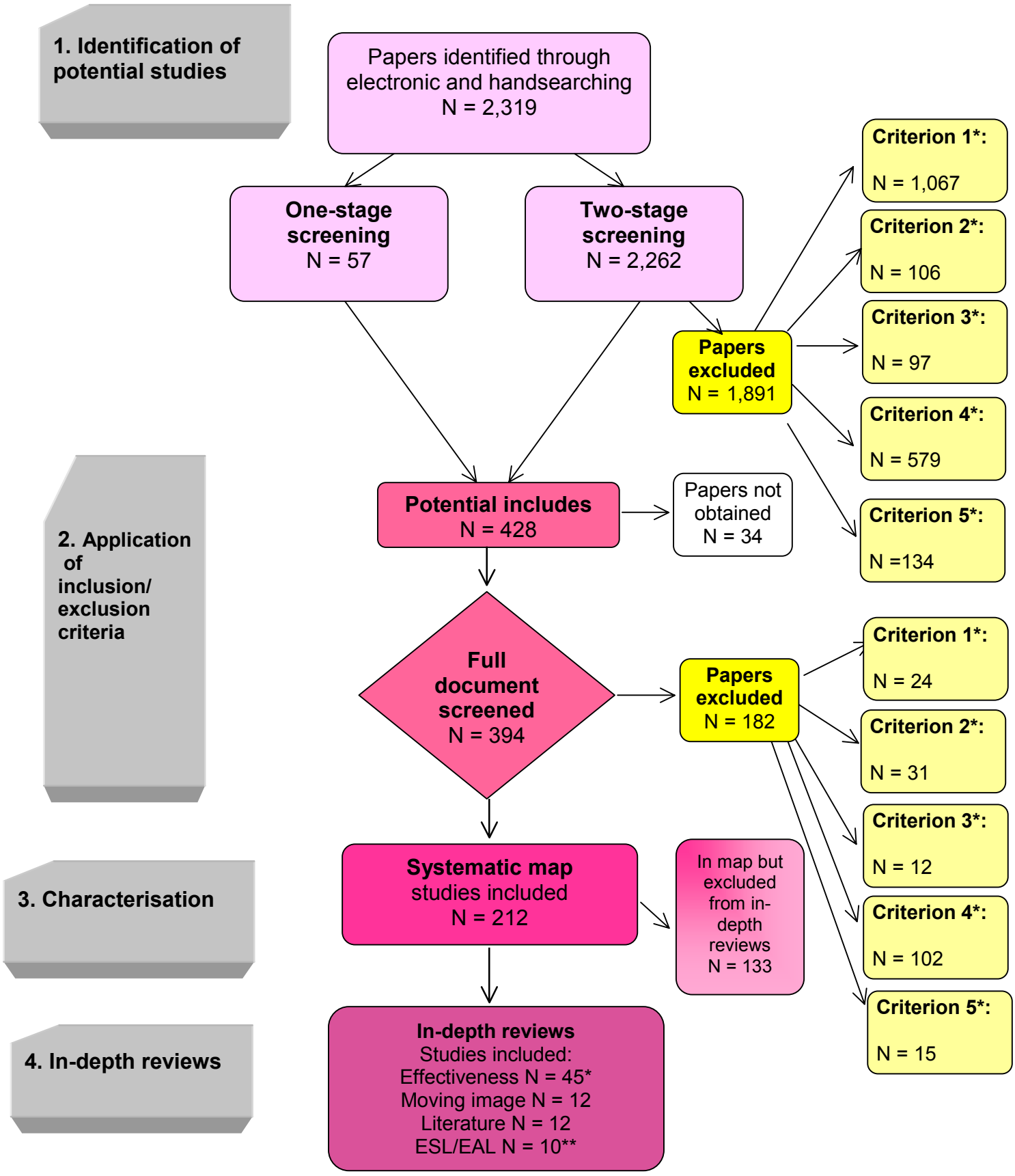
A total of 2,319 potentially relevant reports were identified for the current review. Of these 2,319 reports, 1,891 (just over 81%) were excluded by screening titles and/or abstracts and 428 were sent for. Of the 428 reports, 34 (fewer than 8%) were not received within the timeframe of the review or were unavailable. A reading of the full paper resulted in the exclusion of a further 182 studies, leaving a total of 212 that met the criteria for inclusion in the mapping study. This information is presented in Figure 3.1.

Table 3.1: The process of retrieval of the reports in the mapping study

	Andrews *et al.*, 2002 (revised)	**Review update**	**Current review**
Total number of 'hits'	1,867	452	2,319
Met mapping study inclusion criteria on the basis of the title or abstract	358	70	428
Not received or unavailable	22	12	34
Full reports available	336	58	394
Full reports that did not meet mapping study inclusion criteria	159	23	182
Met mapping study inclusion criteria and keyworded	177	35	212

1 It is possible, for instance, for a report (article, report, book) to include more than one study. This was the case in one of the reports we reviewed.

Figure 3.1: Filtering of papers from searching to map to synthesis – overarching review



*Criteria for exclusion are not mutually exclusive
** Two of the ten studies were excluded in the final review

Table 3.2 presents the origin, by database or other method of retrieval, of all the 212 reports included in the mapping study. It also shows the process of retrieval for each database.

The majority of the reports found to meet the mapping study's inclusion criteria (185: 88%) were found with the database searches. Handsearching found an additional 22 (11%). 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 four and one relevant report respectively. No reports were identified solely through C2-SPECTR or webpage searches.

Table 3.2: Origin of reports in the mapping study

	Found	Included
PsycINFO	849	97
ERIC	880	62
BEI	295	20
SSCI	59	2
Cochrane	26	0
SIGLE	48	2
C2-SPECTR	49	0
DisAbs	56	2
Handsearch	43	22
Citation	8	4
Website	3	0
Contact	3	1
Total	***2,319***	***212***

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.

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

The remaining tables in this section present analyses of the included and keyworded studies contained in the 212 reports.

Table 3.3 shows the number and proportion of studies according to the country in which they were conducted. Most (63%) were conducted in the US. A total of 39 (18%) were from the UK. In three 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 3.3: Study country

	Number
USA	134
UK	39
Australia	17
Canada	15
New Zealand	2
Sweden	1
Netherlands	1
Not stated	3

Note: All studies were conducted in one country only.

Table 3.4 describes the educational setting for the studies. A study could be conducted in more than one setting. Primary education was the most frequently studied. A total of 32 studies were conducted in both primary and secondary settings. Thirty studies were conducted in other settings, including independent schools, special needs schools and the home.

Table 3.4: Educational setting

	Number
Primary education	140
Secondary education	74
Other	30

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

Table 3.5 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 studies identified, about two-thirds (62%) assume a psychological representation of literacy. One-third (34%) adopt a more sociological conception of the practice. Two-thirds (62%) focus on writing, graphical or pictorial production, whereas half (50%) 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 for which reviewers were unable to categorise the aspect of literacy under study.

Table 3.5: Principal aspect(s) of literacy

	Number
Conceptualisation of literacy	
Psychological aspects or representations	131
Social representations and/or cultural/critical representations	73
Unclear	21
Reading/writing	
Writing print and graphical or pictorial representation	131
Reading print and graphical or pictorial representation	106

	Number
Unclear	5

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

Table 3.6 shows the overall distribution of reports according to study type. Most (179) of the 212 reports meeting the inclusion criteria for the mapping study evaluated outcomes; 169 of these were researcher-manipulated and 10 were naturally-occurring evaluations. Of the 169 researcher-manipulated evaluations, 45 were RCTs, 84 were trials and 41 were other types of evaluation. One report contained both an RCT and a non-randomised controlled trial.

Table 3.6: Study type

	Number
Evaluation: researcher-manipulated	169
RCT	45
Trial	84
Other	41
Evaluation: naturally-occurring	10
Exploration of relationships	28
Description	3
Review	6
Systematic review	5
Other review	1

Note: Studies could be defined as more than one type.

The type of ICT focused on by the identified studies is illustrated by Table 3.7. 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 3.7: Type of ICT

	Number
Computer – stand-alone (software)	191
Computer – networked (email and/or internet)	24
Computer – networked (email)	20
Computer – networked (internet)	11

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

Table 3.8 illustrates the process of identification by keyword of reports for inclusion in the four specific in-depth reviews. Each report was subject to the inclusion/exclusion criteria of the specific in-depth review for which it was identified. This process is described in the individual review reports contained in sections 4(a) to 4(d).

Table 3.8: Identification of reports for inclusion in the specific in-depth reviews

Keyword	Total reports
RCT	45

Keyword	Total reports
Moving image	12
Literature	12
ESL	10

Note: Reports could be included in more than one in-depth review.

3.3 Identifying and describing studies in the descriptive map of the overarching review: quality assurance results

Screening

The inter-rater reliability score between CT and RA was 0.65 (good); the inter-rater reliability score between CT and SB was 0.39 (fair); and the inter-rater reliability score between CT and DE was 0.36 (fair). CT and RA were initially less inclusive, possibly because of greater experience of screening educational databases. SB and DE were consistently more cautious in excluding papers in the initial screening, including papers where there was any doubt.

Keywording: EPPI-Centre generic keywording sheet

Inter-rater agreement was very high. From a total possible 180 keywords, disagreement occurred in only 30 keywords (i.e. 16.7%). Most of these disagreements (19) were in the area of study topic (keyword 6) where the EPPI-Centre members were consistently more inclusive. Review Team members coded all 18 papers as 'curriculum'. The two EPPI-Centre members coded these 18 papers as 'curriculum' but in all cases also coded them as 'assessment' and/or 'teaching and learning'. The other 11 disagreements were mainly omissions, and disagreement on educational institution and age.

Keywording: English Review Group ICT and literacy keywording sheet

Agreement was again very good. From a total possible 794 keywords, disagreement occurred in 88 cases (i.e. 11%). Most of the disagreements were additions by members of the EPPI-Centre in keywords 14 and 17 (again due to them being more inclusive), and omissions by the members of the EPPI-Centre in keyword 16 where members of the Review Team tended to apply a keyword to both a *and* b. In addition, there were a few disagreements on study type. It was anticipated that these disagreements would be resolved at the data-extraction stage. The results of this quality assurance exercise highlight the importance of including a glossary for review-specific keywords.

3.4 Studies included in the in-depth study from searching and screening

A total of 10 studies were isolated on the basis of the original keywording. Of these, two studies failed to meet the criteria: Bigum *et al.* (1997) and McNamee (1995).

One of these studies, the three-volume Digital Rhetorics (Bigum *et al.,* 1997) contained a very extensive review of previous research and thinking about literacy and literacy teaching, but was excluded on three grounds: primarily (a) there was no definable body of systematically-gathered data that could be (or had been) subjected to detailed analysis; secondarily (b) there was use of considerable, seemingly subjective, field coding; and (c) ESL students were not reported separately in a clear way.

A second report, McNamee (1995) was restricted to African-American students, so was excluded on the grounds of not meeting the criteria for being ESL.

This left eight studies in the in-depth review:

Decosta (1992)
Lin *et al.* (1991)
Nwogu and Nwogu (1992)
Parr (1997)
Silver and Repa (1993)
Sinatra *et al.* (1994)
Van Haalen and Bright (1993)
Williams and Williams (2000)

3.5 Identifying and describing studies: quality assurance results

Both reviewers and the moderator working independently and applying the procedures detailed in sections 2.2 and 2.3 agreed on the studies which were included and excluded. Several debatable, or unclear, cases were included (see section 4.1 below), but their review-specific weight of evidence was categorised as low.

4. IN-DEPTH REVIEW: RESULTS

4.1 Selecting studies for the in-depth review

Studies were included in the in-depth review if they matched the content-based and methodological criteria listed earlier.

In four of the included studies – Lin *et al.* (1991), Decosta (1992), Sinatra *et al.* (1994) and Parr (1997) – it was not clear whether the students were genuinely ESL.

Lin *et al.* (1991) have a Chinese American group, but all the students are above the 21st percentile on the English Language Assessment Battery, which is used by the New York City Board of Education to determine eligibility for 'bilingual services'. The researchers include 'cultural background' as a factor in their analysis, but do not discuss the topic, beyond suggesting the universal value of their treatment (p.24). The paper was given the benefit of the doubt and included.

Decosta (1992) describes the local community as predominantly 'Italian and Eastern European in heritage' with 35 percent Afro-Americans (p 17). The make-up of the sample observed is not, however, reported, so the proportion of Afro-Americans, who are not here classified as ESL, is not known. Secondly, the children are described as being second, or even third generation, immigrants, but no English language proficiency data or home language background is provided, so it is hard to know whether even the Italian or East European children can validly be seen as ESL. The paper was given the benefit of the doubt and included.

The third study, Sinatra *et al.* (1994), resembles Decosta, in that it gives a linguistic breakdown of the local area, but does not directly state the profile of the group(s) studied. Again like Decosta, the local area contains a mixture of possibly ESL and (for this review) clearly non-ESL inhabitants: Hispanic (46%), speakers of languages other than Spanish (26%), Afro-Caribbean (6%) and undefined (26%) – but presumably native English speaking and white. The reader is led to infer a research group profile of 72 percent ESL, but the scores of these children are not reported separately. The study was given the benefit of the doubt and included and classified as ESL, but its overall weight of evidence for the review question could not be high.

In Parr (1997), there are two ESOL groups from whom data are gathered, but whose results are not reported. There is also a Maori ethnic group in the classes whose results are reported, but these have similar reading scores to their 'European' peers. Lastly, an F3 Learning Support Group and a Waipareia group are noted, but the ethnic/linguistic composition is not reported for either. The Parr paper was given the benefit of the doubt and included, but the overall weight of evidence with respect to the review questions was necessarily low.

A different situation was posed by the Williams and Williams (2000) study. The title used EFL rather than ESL and no background information was reported about the students studied. However, as the term ESL was used consistently in the body of the article and the initial discussion related to mainstreaming within

the regular education system, the study was given the benefit of the doubt and included and categorised as ESL-related.

The Williams and Williams paper illustrated a further classification problem. This was the fact that, although there was an intervention and the students typed words into a computer, it was not clear whether the computer had played any real part in the gains made. Again, the paper was given the benefit of the doubt and included, although its value in answering the review question was hence inevitably low.

The Decosta (1992) study involved a second problem with respect to the inclusion/exclusion criteria, in addition to the ESL one discussed above. This was the fact that the paper claimed to be a spin-off from an ongoing study involving six intact classes. The paper involved a commentary on selected texts drawn from the study, but no research design or research questions were reported, no research methodology was described and no systematic analysis (even of the texts cited) was described or evident. The paper was thus marginal about whether there could be said to be a literacy-based research project, where data were systematically collected and analysed. With some misgivings, the paper was given the benefit of the doubt and included, largely on account of the fact that it included more discussion of situational and pedagogical details than the other studies.

The final result is that there is some doubt about how far five of the studies do in fact meet the inclusion criteria. Indeed, just three of the eight studies are clearly classifiable as ESL: Nwogu and Nwogu (1992), Silver and Repa (1993) and Van Haalen and Bright (1993), although even in the latter, the bilingual and monolingual speakers were relatively balanced as regards English language proficiency. After considerable discussion, the decision was taken that the less clear-cut cases would be included in the study, as their inclusion provided a much richer set of data and because the weight of evidence indicators allowed provisos to be made where necessary.

The overall inclusion situation is summarised in Table 4.1.

Table 4.1: All studies keyworded as ESL indicating numbers included and excluded

	Number
Total number of keyworded ESL	10
Excluded for failure to meet criteria	2
Not ESL	1
No analysed data	1
Total number of studies in the in-depth review	8

4.2 Studies selected for in-depth review

The eight studies in the in-depth review varied with respect to the aspect(s) of literacy involved, the country where the study was carried out and the type of research involved. These details are summarised in Table 4.2.

Table 4.2: Focus and type of research of included studies

Study	Country	Literacy	Evaluation type
Decosta (1992)	USA	Writing: narrative	Unclear
Lin *et al.* (1991)	USA	Reading: word recognition	RCT
Nwogu and Nwogu (1992)	UK	Reading + writing? (unclear)	Naturally-occurring
Parr (1997)	NZ	Reading generally	Naturally-occurring
Silver and Repa (1993)	USA	Writing: (genre unclear)	Researcher-manipulated
Sinatra *et al.* (1994)	USA	Reading + writing: narrative	Researcher-manipulated
Van Haalen and Bright (1993)	USA	Writing: narrative	Researcher-manipulated
Williams and Williams (2000)	USA	Reading + writing: transcription	Naturally-occurring

The eight studies also vary in terms of the age group and the nationalities involved. Essentially, four studies involve secondary-level students (here defined as 11 to 16 year-olds) and four primary level students (5 to 10 year-olds). One study (Van Haalen and Bright,1993) involves US Grade 5; this has been classed as primary. As regards nationality, there is a wide variety; the only common factor is that three studies (Silver and Repa, 1993; Sinatra, 1994; Van Haalen and Bright, 1993) have a high proportion of (American) Hispanic students. The situation is summarised in Table 4.3, with further details of the methodology and the results in Appendix 4.1.

Table 4.3: Student age and nationality in included studies

Study	Country	Age	Evaluation type
Decosta (1992)	USA	5-10 Kindergarten + Grade 1	Italian; East European; American
Lin *et al.* (1991)	USA	7-8 Grade 2	Chinese American
Nwogu and Nwogu (1992)	UK	11-16? Secondary	Mainly 'of Asian origin'
Parr (1997)	NZ	11-16 F4-F5	Maori, Poly/Melanesian
Silver and Repa (1993)	USA	15 Grade not reported	46%? Hispanic American
Sinatra *et al.* (1994)	USA	9-10 Grade 4	Mainly Hispanic American
Van Haalen and Bright (1993)	USA	10-11 Grade 5	Mexican American
Williams and Williams (2000)	USA	11-16? Ages not reported	Mainly East African

4.3 Weight of evidence of all included studies

The relevance and value of the eight studies for the present review is summarised in Table 4.4.

Table 4.4: General and review-specific weight of evidence (summary)

Study	A	B	C	D
Decosta (1992)	Medium	Medium	Low	Low
Lin *et al.* (1991)	Medium	High	Medium	Medium
Nwogu and Nwogu (1992)	Medium	Medium	Medium	Low*
Parr (1997)	Low	Medium	Low	Low
Silver and Repa (1993)	Medium	Medium	High	Medium
Sinatra *et al.* (1994)	Low	Medium	Low	Low
Van Haalen and Bright (1993)	Medium	Medium	Medium	Medium
Williams and Williams (2000)	Low	Medium	Low	Low

* Categorised as 'low' due to the absence of empirical data and the lack of information about how the method was implemented. The focus is, however, fairly relevant, and the research design could have been implemented more systematically and reported more comprehensively. The findings do, however, appear to be predictable and expected, whence the rating of 'medium' rather than 'low' in column A.

Key

General

A Can findings be trusted in answering study question(s)? (EPPI Q.M11)

Review-specific

B Appropriateness of research design and analysis (EPPI, WOE B)
C Relevance of focus of study (EPPI, WOE C)
D Overall weight of evidence (EPPI, WOE D)

(Bracketed references are to the questions/categories used in the data-extractions. The data-extractions do not form part of the present report.)

4.4 Further details of studies included in the in-depth review

It had been hoped to compare the studies on the basis of features of bilingualism, but none of the included studies devoted much discussion to the topic. Indeed, most studies had no discussion at all on questions of bilingualism, so it was not possible to analyse this topic further. Chapelle's (1990) insistence on the importance of linking classroom behaviour to classroom language was not reflected in the eight studies, so again, no further analysis of this important topic is possible.

Hyland (1993), in a paper examining the factors likely to promote learning via CALL with EFL/ESL classes, noted the likely importance of integrating the CALL sessions and content with the regular curriculum. This is inherently a very plausible hypothesis and one which we had hoped to check in the present review.

Unfortunately, none of the papers details clearly whether integration took place and, if so, how. Silver and Repa (1993) certainly imply that the 'Introduction to Literature 1' course was a normal part of the curriculum and Decosta (1992) implies that the writing work was integrated into part of the children's school day; indeed both also comment on the collaborative learning that Hyland (above) was also concerned about. Parr implies that the reading work was not integrated – indeed, several of the teachers complained about the fact – and the work in Lin *et al.* (1991), Van Haalen and Bright (1993), and Nwogu and Nwogu (1992) seems not to have been integrated. The relationship between the intervention and the regular curriculum in Williams and Williams is not made clear. Given the apparent absence (or low level of) of integration in five of the eight studies and the lack of detail or clarity in two more, the question of integration is therefore not pursued in any real depth.

4.5 Synthesis of evidence

In this section, we comment briefly on each of the eight studies individually, dividing them into primary (under 11 years) and secondary level (11 years and over). The commentary can be read in conjunction with the weight of evidence summary in Table 5.1.

Primary

Decosta (1992) differs from all the other studies in that it is not a report of a systematic observation or intervention. Rather, it is an interpretation/evaluation of text fragments produced by US kindergarten and Grade 1 children who lived in an area of unemployment and social problems, and who were exposed to word-processing. The ICT teaching was heavily integrated into the school day and the class environment and involved a high level of teacher support, collaborative work, redrafting and editing, plus a 'user-friendly' environment. The paper is held to be derived from a larger, ongoing study, but details of this are not reported. Decosta claims that all the children involved were very positive about writing, using the computers. She also shows that some 5-6 year-old children, when encouraged by the teacher and freed from over-concern about the mechanics of writing, will describe their psychological and home problems in their texts. This intensely personal writing is held to be good from a writing point of view as well as allowing teachers or other appropriate persons to help the students concerned. The results of the study are intuitively very plausible and match Hyland's (1993) criteria for progress using CALL, but it is hard to be at all definite, as there are a number of methodological problems: (a) it is unclear how many ESL students are involved in the larger group, (b) only nine children are actually cited in the paper, (c) there is no research design and no systematic sampling or analysis, (d) the timeframe is unclear, and (e) it is unclear how far any effects are due to the computer or a result of good teaching.

Lin *et al.* (1991) represents the only study overtly to include 'mildly mentally handicapped' students as part of the research design. The researchers were interested to discover whether CAI improved word-recognition skills. The sample of 93 children came from ten US elementary schools and involved 'Caucasian' and 'Chinese American' children. The mean chronological age of the 'mildly handicapped' students was 7.8 yr and of the 'non-handicapped' students 8.7 years; their reading age was on the Grade 2 level. Allocation to treatment groups was random. Retention in the study depended on achieving 45%-85% accuracy

and a response time of more than 100 msec. in the pre-test. The intervention consisted of ten lessons. Pre- and post-testing involved the same multiple-choice test, in which students were presented with a word and asked to select the correct version from a set of four choices. The results were complex. With respect to response time, both 'mildly handicapped' and 'non-handicapped' students improved significantly ($p<.001$), but the 'non-handicapped' students ($p<.001$) and the CAI students ($p<.001$) performed significantly faster, with the latter also being less variable ($p<.01$). The 'mildly handicapped' students showed less variance, however ($p<.05$). Further analysis indicated that the greatest response time gains were made by the students with the slowest initial times. With respect to accuracy, the sample had again improved significantly ($p<.001$). This time, however, the pen and paper group was more accurate than the CAI group ($p<.01$) and the 'non-handicapped' group more accurate and less variable than the 'mildly handicapped' group (both $p<.05$). Cultural background had no effect. The authors conclude that CAI and pen and paper methods have differing effects on learning, with the pen and paper group being more accurate and the CAI group being faster. These results do help answer the review question in this one restricted domain, but their generalisability and validity need to be tempered by the following difficulties: (a) it is not clear how far the learners are genuinely ESL (see section 4.1), (b) few details of the pen and paper tests are given, (c) no sample test items are given, (d) there is a clear assumption that multiple choice tests without a discourse context genuinely measure reading ability and that multiple choice format represents a valid way to teach reading, (e) there is no reporting of how far the teaching and testing reflect, or are integrated into, current classroom practice, (f) it is unclear whether the sample is at all representative, and (g) there appear to be ceiling effects in the outcome scores. It is also just possible that there was a halo effect; the CAI group had to be trained how to use a keyboard, so it may be that computers were felt to represent something new and exciting.

Sinatra *et al.* (1994) used a commercial program, seemingly developed by two of the authors, 'Thinking Networks for Reading and Writing Program' to test whether teaching 'at risk Chapter 1' fourth grade ESL students in New York to compose structured storyboard outlines served to improve the quality of their narratives. The procedure was called 'semantic mapping' (although it appears to be heavily discourse rather than semantics oriented) and meant that this was the one study of the eight to be devoted to higher level skills, although Van Haalen and Bright did include them in the analysis. Writing was assessed by using texts taken before and after the intervention and holistically scored using both an overall scale and a composite scale. Attitudes towards computers and towards writing were also gathered. There were originally 260 students from intact classes in six elementary schools, divided into an experimental group of 160 and a control group of 100, who were to be examined over a year's teaching. Unfortunately, 80 students moved from the control to the experimental situation in January, thereby severely unbalancing the groups and reducing the control group to 20. The results showed the experimental group's writing improving significantly ($p<.05$) and the small control group's decreasing. Differential rates of gain indicated that some teachers were more successful than others, with the teachers of the two 'half-year' groups being the most enthusiastic and successful. Ethnicity or L2 was not included in the analysis. Gender was; it proved non-significant with regard to writing quality but when attitude was measured, girls scored significantly higher than boys on (a) the importance of writing ($p<.01$), (b) recognising a link between writing skill and achievement ($p<.001$), and (c) having a positive view of oneself as a writer. While the role of enthusiasm on the part of the teacher is highly likely to be an important factor in success with CALL, it is hard to use the results of the

study to answer the review question. The reasons are (a) the description of the linguistic make-up of the observed sample is hedged (see section 4.1), (b) no separate analysis for the ESL students, or for separate L2s, is carried out, (c) the statistical analysis is seriously impaired, as the authors admit, by the 80 students shifting conditions, (d) attitudes are only measured after the end of the study, not before, (e) the experimental group differs from the control on two major counts, not one as the control used neither a computer nor semantic mapping, (f) no baseline data on initial English levels are reported and (g) the authors admit (p 108) that the control group lacked 'a cohesive plan for in-depth development of a particular discourse form… the narrative'.

Van Haalen and Bright (1993) investigated whether word-processing aided a sample of 42 fifth grade monolingual and bilingual Mexican American students in their writing. The sample was from a Southern US city and appeared to be reasonably representative of the local community. The monolingual group were essentially English language only, although their receptive skills were not reported. Each group received four writing tasks: the first two word-processed, the second two pen and paper. The task involved a pictorial stimulus and students underwent a three-day writing cycle to produce a written narrative. The texts were scored holistically and five types of revision were counted; these ranged from low-level spelling and punctuation to higher level sentence rearrangement and resequencing. The main findings were that (a) significantly more revisions were made in the pen and paper condition than the word-processing condition ($p<.05$), except for word-level revisions, (b) females made more revisions overall than males ($p<.01$), (c) monolinguals made more surface revisions than bilinguals but bilinguals made significantly more phrase-level revisions ($p<.05$), and (d) level of keyboarding skills was a significant regressor in predicting the number of revisions made. With respect to the holistic scores, performance was better in the pen and paper condition than the CALL condition ($p<.001$), but neither bilingualism nor gender affected the results significantly. However, when keyboarding scores were factored in, bilingual students did score significantly higher ($p<.05$). At a general level, the authors noted that, in general, most revisions were at word level and few students made higher level sentence revisions, especially when using the computer. The researchers concluded that both higher level revision and keyboarding skills need to be taught to all students, irrespective of language; lack of keyboarding skills can hold students back from realising their writing potential. The findings do help answer the review question, but a number of methodological or reporting difficulties, in addition to the ESL classification problem mentioned above, limit the definiteness with which one may apply the conclusions. Firstly, there are few details about the writing tasks or the teaching procedures; the seeming lack of any collaborative work or integration with regular schoolwork may have limited the quality of the texts or the number and type of revisions – and this occurred despite the flagging of integration as potentially important (p 314). Secondly, the research design would have been improved if there had been random assignment to treatments and both groups had not received the experimental and control conditions and in the same order. Thirdly, the absence of English proficiency data makes it hard to draw conclusions about linguistic thresholds for tasks. Indeed few baseline data are reported.

Secondary

Nwogu and Nwogu (1992) observed a class of ESL children in a Birmingham (UK) secondary school for four months, then interviewed the teacher and gave a

26-item questionnaire to a random selection of 10 children. The school had been selected as the only one found matching seven criteria. These included having timetabled CALL sessions for ESL students, reasonable access times, CALL materials and a CALL-trained teacher. The sample is not clearly described, but was largely of South Asian origin and comprised a mixture of students with differing characteristics, from recent arrivals in the UK to children with (moderate) hearing difficulties. No age profile is reported, but most of the children had a reading age of less than eight years. The researchers noted that there were very few computers available to the ESL children (in fact, just one BBC computer), that access time was severely limited and that the CALL programs available were designed for native speakers, with their drill-like structure making them unsuited to modern ideas of communicative or task-based language teaching. The results of the questionnaire, however, showed that the children were very enthusiastic about the CALL sessions and attributed considerable learning gains to them. The finding that few computers were available to ESL students in Birmingham schools in the early 1990s is very plausible, as is the claim that little real progress can be expected without CALL programs that are compatible with good language teaching practice. However, as no empirical data are reported, the study cannot be held to really show anything about ICT and ESL learners. In addition, the study is let down by (a) the absence of any analysis of the observations, (b) conflating the results from other schools, or conclusions from general knowledge, with those of the class observed, (c) not reporting what CALL was in fact observed, and (d) reporting the questionnaire results and procedure in an anecdotal and unquantified way.

Parr (1997) is a study of how intact classes of New Zealand secondary children, both ESL and non-ESL, reacted to the use of the American 'SuccessMaker' program, designed to improve reading and maths skills. Over an academic year, a range of students with ages, academic levels and exposure times was observed and their learning gains rechecked several months later. Parr concludes that there were initial reading gains by Form 3 (F3), Form 3 Learning Support and Form 4 (F4) students, but that, when standard reading tests were used, the gains did not last. Parr suggests that the multiple-choice questions initially confused the New Zealand students (who were unused to the concept), but that they mastered the idea rapidly and made considerable gains. However, the multiple-choice format did little to enhance learning in the longer term. Comparisons between Maori and European students were non-significant, although there was a gender effect: girls scored significantly higher than boys ($p < .05$). Sixty-three students, both frequent and non-frequent users of 'SuccessMaker', were interviewed and 70 percent felt they had made good progress on 'SuccessMaker'. Roughly one-third had been bored (n=21) and one-third had been motivated (n=26). Ten students liked the absence of writing and ten liked being in control. Unquantified effects on the teachers were that several felt their role had been eased by the program, but some felt disengaged. There are serious difficulties in using these results to answer the research question in this review. The main problems are that (a) the progress of the ESL students is not reported; (b) it is unclear whether the Maori students in F3 and F4 should be seen as ESL, as their English proficiency was similar to that of the European students; (c) the make-up of the F3 Learning Support Group (who made the most gains) is unreported; (d) comparing reading scores with those of the previous year's students can only be a very partial and non-ideal control; (e) baseline data on reading skills were available, but do not appear to have been used; (f) the questionnaire and interview data are mostly reported in anecdotal form, or not reported at all (e.g. the self-report questionnaire); and (g) no statistical test for the standardised reading test scores is reported. Finally, it has to be said that both

reviewers found it extremely hard to disentangle the precise details of the sample, the research design and some of the results.

Silver and Repa (1993) examined whether word-processing would improve the writing skills and self-esteem of 66 beginning ESL students (aged 15-16) in an urban New York secondary school. The authors took four intact classes studying 'Introduction to Literature 1' and conducted a pre-test/post-test study, lasting 13 weeks. The experimental group met for 18 sessions of 70 minutes and learned, during the classes, to compose on the computer, using 'Wordperfect Junior'. Self-esteem was measured using the Coopersmith Self-Esteem Inventory and a teacher-report Behavioural Academic Self-Esteem scale. Writing proficiency was measured using text samples rated holistically in accordance with the CUNY Writing Skills Assessment Test Evaluation Scale. The findings were that the experimental group's writing quality increased significantly ($p<.05$), but that self-esteem ratings did not, although 'all but two students developed a positive attitude toward writing' (p 277). The authors concluded that (a) 13 weeks was possibly not long enough to increase self-esteem; (b) collaborative assignments were 'aided by using word processing' (p 275); (c) collaborations 'were made easier when each member of the group was given a legible printout' (p 275); (d) use of the computer generated more writing (than not using it); and (e) teachers in computer-aided sessions tended to become facilitators. The study is let down slightly by not using the pre-test data when measuring post-test gain (i.e. Analysis of Covariance is not employed) and by the fact that the experimental group appears to have done more writing than the control group. The lack of comparison with a non-ESL group, or between the L2 groups involved also limits the value of the findings, as does the lack of investigation of the textual and strategic differences between the writing samples. The four unquantified results are of particular interest, as they match Hyland's proposed criteria for learning gains using CALL, but the very fact of the comments being vague in scope and unquantified means that one cannot really generalise from them. One should perhaps also note that the school was an alternative school, with a very high commitment to, and provision of, student support.

Williams and Williams (2000) were concerned to test out a new way of teaching 21 ESL students in a North Western US secondary school who could not follow the teacher or the course successfully. The aim was to improve students' reading by use of a combination of reading (and reading aloud), oral repetition and copying/transcribing the text (words, then phrases, then sentences) into the computer. The authors measured progress after one semester and claimed a marked improvement. The study is let down by a number of factors. Apart from the classification problems noted already in section 4.1, the main difficulties are that the research question and the nature of the students' problems are not adequately discussed; the pre-test data are unclear; the relative contribution of the different aspects of the treatment (such as repetition, writing, using the computer) is neither addressed nor discussed; and the nature of 'correctness' is not addressed. The result is that, while the idea of measuring learning gain from an integrated-skill treatment is good in outline, the lack of theoretical discussion, of an appropriate research design, of attempts to address validity or reliability, and of appropriate statistical analysis make it impossible to draw any real conclusions about the role of ICT in helping the students improve their literacy skills.

4.6 In-depth review: quality assurance results

Both reviewers were in agreement with respect to the studies finally included in the in-depth review, albeit with the provisos mentioned already in section 4.1. The eight studies were independently data-extracted by GL and SB (six studies) or GL and the moderator, CT, (two studies). The data-extractions were compared via extended face-to-face interviews and any areas of disagreement resolved. The English Review Group data-extraction for each of the studies was uploaded.

4.7 Synthesis of findings from studies of in-depth review

In the final analysis, several studies have produced suggestive ideas, but just three studies rate as having at least 'medium' weight of evidence (Lin *et al.*, 1991; Silver and Repa, 1993; Van Haalen and Bright, 1993); see Table 4.4. Of these, there is some doubt about the validity of the ESL status of the studies reported by Lin *et al.* and Van Haalen and Bright. Our conclusions below are based primarily on the medium- weight studies. Where details of the low weight studies are not problematic, these have at times been drawn on; on other occasions, a detail from a low weight study has been mentioned, but either the weighting has been explicitly noted, or information from the medium-weight studies has been used in support or contrast.

Impact on the educational system

Despite a lack of generalisable empirical evidence and the low weight of evidence rating, Nwogu and Nwogu's (1992) conclusion seems reasonable: namely that no proper CALL teaching or learning can take place with ESL students, unless there are adequate numbers of available computers, CALL programs are adaptable and fit current approaches to language teaching, there are CALL-trained ESL teaching staff, students each receive adequate access time, and CALL sessions are timetabled/integrated into the regular school programme. This agrees with Silver and Repa's (1993) task-based approach, whereby CALL students worked collaboratively and had a goal (publishing on the web). Decosta's (1992) findings do not carry a medium or high weight of evidence for this review, but they do support the need to integrate CALL classes and work into the regular curriculum and a user-friendly, collaborative environment. Hyland's (1993) proposal to this effect is thus supported by the studies in this review. Impact on the 'system' may be taken to indicate impact on the classroom.

Chapelle (1990, section 1.1) considered what actually goes on in the classroom to be a key determinant of success with CALL. Although a successful classroom is described by Decosta (1992), her description is rather lyrical and at a general level. The remaining studies touch periodically on classroom activity, but there is no detailed account and no attempt at recording or measuring it. There is, moreover, no indication of ways in which classrooms or class activities were modified as a result of the observations or interventions.

Impact on the student

The effect of word-processing proved variable: Van Haalen and Bright's (1993) primary students wrote better narratives using pen and paper, while Silver and Repa's secondary students wrote better on the computer. In spite of the methodological problems with the study, Sinatra *et al.* (1994) identified the

enthusiasm of the class teacher as a major determinant of success with CALL, but neither Van Haalen and Bright, nor Silver and Repa (1993) examined this.

Lin *et al.* commented that, at least for low-level tasks such as word-recognition, there may be a trade-off between speed (using a computer) and accuracy (using pen and paper). The notion of different media enhancing different skills is intuitively very plausible, but unfortunately none of the other studies address it. Van Haalen and Bright's distinction between number and type of revisions and overall quality is not quite the same.

Although Sinatra *et al.* (1994) (low weight) did ask for discourse level activities and approached them in a structured way, other studies, such as Van Haalen and Bright, found that few students used word-processors to carry out sentence level revisions. Even though the Sinatra study does not directly answer the question for ESL students, our conclusion is that some discourse level revision is likely to be possible with ESL primary and secondary students, but only with strong support from the teacher, the CALL materials and the teaching environment. Van Haalen and Bright recommend that such techniques are worth teaching; we support this but feel that more research is needed to indicate the limitations and the possibilities.

Two studies found that students with lower starting proficiency made the greatest gains. Parr (1997) (low weight of evidence) found that the F3 Learning Support Group made the greatest reading score gains (using a multiple-choice approach) and Lin *et al.* (1991) found that the greatest response time gains for word-recognition were made by the students with the slowest initial times. Both studies involved fairly mechanical learning tasks and this may be the key. It is unclear whether Parr's Learning Support Group contained any ESL students, but the Nwogu and Nwogu (1992) study might, despite its low evidence weight, provide some indirect support, in that the observed group contained students with learning difficulties and mild handicaps and the teaching involved fairly mechanical approaches to pre-reading activities; however, all the ten students who responded to the questionnaire attributed personal learning gains to the CALL sessions.

Impact with respect to gender

Three studies found a gender effect in favour of girls: Parr (1997), Sinatra *et al.* (1994) and Van Haalen and Bright(1993). Parr's sample for this effect contains primarily F3 and F4 children who appear not to be ESL, so the gender effect cannot really be endorsed in the context of this review. Van Haalen and Bright found that, while the quality of narratives was similar for girls and boys, girls made significantly more revisions than boys. Sinatra *et al.* also found a gender difference among attitudes, with girls developing a better attitude towards writing, and in particular being more aware of the importance of writing, the link between writing and achievement, and showing a more positive view of themselves as writers. All of these findings could easily be accounted for if the girls were slightly more mature than the boys, but as the evidence stands, no common underlying factor can be clearly identified from the studies reviewed.

Impact with respect to ethnicity

Only Van Haalen and Bright (1993) report a significant difference for ESL students, with respect to the type of revisions made, but this result may well be due more to the fact of relatively balanced bilingualism on the part of those who performed better. This would indeed support the notion that bilingualism can confer advantages with respect to cognitive skills, but this conclusion requires a

linguistic threshold to have been reached. Lin *et al.* (1991) did not find a language or ethnicity effect, but they did comment on the notion of a threshold, noting that certain tasks might work against ESL students whose English is below a certain threshold. With no more evidence, all that can be concluded here is that thresholds are likely to be important in several aspects of CALL, but more detailed research is needed. In short, the studies in the review suggest that, where the task is appropriate to students' needs and their language and intellectual level, CALL materials are as useful for teaching ESL students, whether mildly mentally handicapped or non-handicapped, as they are for teaching English mother-tongue students.

Impact with respect to student attitude/opinion

Although the opinions of students of all ages, primary and secondary, tended to be more or less positive about the use of computers, this trend was not universal. Twenty-one of the 63 students in Parr's study who reported their opinions considered 'SuccessMaker' boring, although again it is unclear if any of these were genuinely ESL (whence the low weight of evidence). The reviewers had expected to find a marked gender effect, with girls being more negative than boys, but the effect only occurred in Sinatra *et al.* (1994; again low weighted) and that was the inverse. The data in the eight studies are not adequate to decide which students liked which sort of CALL programs and which sort of tasks / work.

Impact with respect to staff attitude or behaviour

To Hyland (1993, see section 1.1), teachers, not computers, are the key to successful learning via CALL. The point is strongly endorsed by writers from Farrington (1989: 70), to Sussex (1991: 21) and Levy (1997: 231). Unfortunately the studies in the review did not focus on teachers in any great detail. Rather, the impact on and of the teacher tended to be reported anecdotally in all cases, even where precise data-collection measures had apparently been adopted. Silver and Repa (1993) as well as Decosta (1992) noted that the CALL teacher became a facilitator, rather than the imparter of wisdom, bringing CALL teaching into line with modern views of regular class-based language teaching. Sinatra *et al.* (1994) also noted that the greatest learning gain was made by the two classes with highly enthusiastic teachers; there is little data about teacher enthusiasm in the other studies, although Parr (1997) reported that some teachers (unquantified) were less enthusiastic than others and simply disengaged in the CALL classes. This situation presumably supports Nwogu and Nwogu's (1992) assertion that trained CALL teachers are an important requirement for success in using ICT with ESL, or one suspects any other, students.

5. FINDINGS AND IMPLICATIONS

5.1 Scope of the study

The term 'written literacy' covers a broad range of reading, writing and thinking skills, involving 'lower level' activities such as automatic responses, or basic spelling and punctuation to 'higher level' activities, such as re-editing the propositions of an argument or narrative. The impact of a technology, such as ICT, is likely to be complex and variable, depending on social, psychological and other factors (see Haas, 1996). The eight studies selected for the in-depth review cover a broad range of ICT and literacy focuses. The majority of the studies focus more on lower level literacy skills, although several studies do report that they had hoped students would carry out more higher level editing. The fact that the majority date from the early 1990s explains the lack of internet-based studies.

5.2 Comments on the nature of studies selected for in-depth review

The reviewers noted that the eight studies comprise a range of investigatory approaches. No single research design predominates. There appears to be a general lack of rigour across the studies, with issues of reliability and validity in particular attracting low recognition. Two studies (Parr, 1997; Sinatra *et al.*, 1994) are designed to test/explore the impact of a commercial CALL package. No discussion about interested parties is presented, for example. Parr in particular is concerned to observe the impact of a US package in a non-US environment. There is no discussion of the methodological issues this might raise. Nwogu and Nwogu (1992) are more concerned with observing what happens in a classroom and documenting problems. Interpretation is very slight. There is just one RCT (Lin *et al.*, 1993), although two other studies employ some form of control group and a pre-test/post-test design: Silver and Repa (1993) and Sinatra *et al.* (1994). One study (Van Haalen and Bright, 1993) has a control condition, rather than a control group, and all students receive both the control and experimental treatments. The Williams and Williams study (2000) is a before and after evaluation (the term being used to refer to a more informal situation than 'pre-test/post-test') of a single group that was formed to resolve a learning need and who all underwent the same teaching. Finally, one study is more a qualitative interpretation of selected text data from an evaluation study: Decosta (1992).

The relationship between investigator and teacher appears to be relatively homogeneous. In seven cases, the researcher seems not to have been the teacher, but in one case (Williams and Williams, 2000) one of the authors was.

Only one study explicitly builds 'mildly mentally handicapped' students into the research design (Lin *et al.*, 1991), although other studies may have a number of similar students in the sample: Nwogu and Nwogu (1992), for example, mention their existence in the class, but do not report any numbers, or analyse them separately.

5.3 Discussion of the findings

The small number of included studies, the variable focus of those included and the difficulties with (a) categorisation as ESL and (b) weight of evidence make it hard to show clear-cut findings. With respect to the educational system, the suggestion is that ICT can help ESL students if there are sufficient computers for students to work on, if the programs and activities are tailored to ESL students' needs, and if the work is integrated into regular teaching (implying that it should be timetabled). The suggestion that collaborative work is desirable also impacts on the educational system in that it requires computers to be positioned and equipped in such a way that collaborative work is possible. This would seem to require at the very least adequate workspace round each computer and multiple headphone sockets.

The impact on students was again not clear-cut. Some students composed more efficiently, using computers, others using pen and paper. The finding that few students in any studies used the computer to help revise their work above word level does, however, suggest that some training needs to be given in higher-level word-processing techniques. It could, however, equally be taken to imply that discourse-level editing is better done away from the computer, on a hard-copy version. None of the studies reviewed discussed at any length the question of what exactly higher-level editing might involve and what the advantages and disadvantages of doing it on a computer might be.

There was reasonable agreement that ICT-based work can appeal to students and teachers, as measured by attitude/opinion tests. Although the appeal was not universal (and no-one would expect every student to prefer working on a computer), it was interesting to note that there was no report of girls rejecting, or even particularly disliking, computer-based instruction.

The need for effective teacher training/development is apparent from the studies, even though it is not discussed by all. Parr (1997) in particular observed that some teachers saw an ICT-based class as an opportunity to relax, or at least to engage less with the class. A related point concerns what teachers do – or encourage learners to do – with the end product. While CALL theorists emphasise the need to integrate CALL work into regular classroom practices and language learning theory emphasises the need for authentic, meaningful tasks (for example, Doughty, 2003; Doughty and Long, 2003), few of the studies reviewed, apart from Decosta (1992), discuss the way CALL 'texts' can be displayed, disseminated or used by class members or by a wider audience. The questions of display and feedback need further investigation.

The lack of detail concerning the nature of the bilingualism involved, and in several cases of the first languages/cultures involved, are serious omissions and make it hard to conclude anything definite from the studies reviewed, apart from the fact that, if appropriate materials were provided, ESL students in general did not seem to be particularly disadvantaged by ICT-based work. This, however, begs the question of precisely how certain types of learner, operating in certain types of situation, could best be taught, in order to maximise literacy learning.

5.4 Strengths and limitations of this systematic review

5.4.1 Strengths

The general approach taken in this analysis is an applied linguistic one. The primary strength of the review thus lies in a close analysis of the sample, the task and the investigatory method; it is, we trust, informed by research and concepts in language education.

The review also has a possible strength that was not anticipated, with respect to the question of collaborative work between students. Most of the included studies happened to date from the early 1990s, when there were fewer computers in schools for students to use. This lack of hardware is likely to make extensive individual use of machines difficult, so shared or collaborative work may well be suggested by the teacher simply as a means of overcoming the problem, or else arise spontaneously among students who would otherwise have to compete for scarce resources.

5.4.2 Limitations

The primary limitation of the review is that it is small. There are only eight included studies and, of these, none were deemed to provide a 'high' weight of evidence to answer the question at hand; indeed, only three were deemed 'medium'. The reasons for not categorising the weight as 'high' differed, although the fact that the sample was not clearly ESL for five of them was a major contributing factor. The result inevitably remains that it is hard to draw any firm conclusions or draw much in the way of implications for policy.

Unlike Andrews *et al.* (2002), this report looked specifically for relevant details of the learning environment and sample: for characteristics of bilingualism in the individual or society, for example, or for details of classroom practice. The virtual absence of any such detail from seven of the studies included means that the review is far more limited in scope than had originally been intended.

The fact that most of the included studies (six of the eight) dated from the early 1990s also imposes limitations on the value of the review for policy-making in the 21st century. The first limitation stems from the simple fact that technology has moved on. Even 'basic' entry-level computers are far faster and displays are no longer text-based. Computer programs are larger, more visual, more inclusive, more interactive in many cases, more integrated to email and the web and more likely to form part of an integrated suite. Thus, a 1990 study which reported solely on word-processing, for example, was making a more inclusive and universal statement then than it would be now. Perhaps the most important change, however, lies in the explosion of email and web-based communication by children in their own homes. This may well link with the explosion of mobile phone use by the same generation, with the consequent widespread use of texting. There are two significant implications of this for the present review. The first is that students are far more confident about, and competent at, using the hardware than a decade ago. The second implication is that the degree of constant exposure to emails and web pages is likely to have reduced (or entirely removed) the feeling that ICT is something new and exciting. A third implication, which none of the included studies addresses, is that children's use of ICT for such things as fast games, alters the nature of pre-course training from how to cope with a computer to how to slow down and concentrate.

5.5 Implications

Given that (a) it was not clear for five of the eight studies included in the in-depth review whether the learners could genuinely be categorised as ESL, and that (b) five studies were allocated a 'low' level of overall weight of evidence, with the remaining three studies only being allocated a 'medium' rating, the overall implication is that there is no substantial body of evidence pointing in any direction regarding the research question.

The primary implication (or, in effect, recommendation) is thus that more research needs to be carried out, but taking the nature of the learners and the nature of the bilingualism involved more into consideration and actively reporting on the impact of instruction on ESL students. To be useful for policy or to aid instruction, research also needs to take account of the impact of recent technology, such as the internet, and, given the popularity of playing computer games and of 'surfing the net' in a domestic environment, to take greater account of learners' pre-existing ICT skills and attitudes.

The following more detailed implications are presented, therefore, with a high degree of caution.

5.5.1 Policy

- Introduction and development of ICT-based ESL programmes should be on the basis of careful preliminary consideration of the intended role of the computer and software, as Hyland (1993) suggested. There was a lack of clarity in some studies over whether the computer/software was in fact adding anything unique into the learning process that could not be achieved by other means.
- The specific and unique role of ICT in improving literacy, especially writing skills, needs to be clear and observed by practitioners.
- The rise in motivation that ICT can produce should be brought to teachers' attention.
- It is not clear what ICT has to offer ESL as a group of learners as distinct from other learner groups (such as Special Educational Needs (SEN), EFL, at-risk learners). Until such evidence is forthcoming, policymakers should review evidence from wider-ranging studies on the impact of ICT.

5.5.2 Practice

- The shift which can be caused by ICT-based ESL programmes in the teacher's role may imply the need for pre- and in-service training courses to address how teachers can effectively facilitate learning through ICT;
- Further training, again through pre- and in-service courses, is needed to develop greater use of ICT's potential in text-manipulation and other higher-order literacy skills.

5.5.3 Research

The primary implication/recommendation (above) implies that, however it is undertaken, and whether the method is ethnographic or involves an RCT, future research on the impact of ICT on literacy for ESL learners needs to address at least the following four areas:

- learners' ethnicity and existing level of proficiency in English;
- the nature and degree of bilingualism involved, with respect to the sample tested, and not simply the surrounding community;
- the learning processes which particular items of ESL software engender;
- the relationship between those processes and the learning processes of the mainstream classroom and the culture at large.

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APPENDIX 2.1: Inclusion and exclusion criteria

English Review Group Working Document

Systematic review on *The impact of 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.

∗ A non-evaluated non-intervention would typically describe a naturally-occurring phenomenon, rather than evaluate it. So an ethnographic case study of a classroom, or a learning site of some other kind, could fall into this category if it did not attempt to evaluate processes or outcomes. Of course, all description is a kind of evaluation (as it will be based on selection according to certain principles), but, if those principles are not articulated, then it is hard to judge the work as research.

APPENDIX 2.2: Search strategy for electronic databases

ICT AND LITERACY – UPDATE SEARCHES

Searcher: Julie Glanville, NHS Centre for Reviews and Dissemination
Completed 20 August 2002

1. Databases

1a. ERIC

ERIC was searched on 16 August 2002, using the BIDS Ovid interface. The database was searched for the period of updates May 2001 to June 2002 and 181 records were retrieved. The records were loaded into an Endnote library.

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. 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. 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).mp.
45. (computer$ adj3 literacies).mp.
46. (computer$ adj3 read).mp.
47. (computer$ adj3 reading).mp.
48. (computer$ adj3 spell).mp.
49. (computer$ adj3 spelling).mp.
50. (computer$ adj3 write).mp.
51. (computer$ adj3 writing).mp.
52. (computer$ adj3 learn).mp.
53. (computer$ adj3 learning).mp.
54. (cal adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
55. (cai adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
56. (call adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
57. (multimedia adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
58. (ict adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
59. (www adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
60. (software adj3 (read or reading or spell or spelling or write or writing or learn or learning)).mp.
61. or/44-60
62. 61 not (43 or 41)
63. limit 62 to english language
64. 50 and 12
65. 63 and 12
66. 65 or 42
67. 65 or 43
68. ("200105" or "200106" or "200107" or "200108" or "200109" or "200110" or "200111" or "200112" or "200201" or "200202" or "200203" or "200204" or "200205" or "200206").em.
69. 67 and 68

1b. British Education Index

The BEI was searched on 19 August 2002, using the BIDS Ovid interface. The database was searched for the updates first quarter 2001 to first quarter 2002 and 67 records were retrieved. The records were loaded into an Endnote library.

1. ict.mp.
2. (information adj technolog$).mp.
3. (communication adj technolog$).mp.
4. (cal or cai or computer$ or multimodal or multimedia).mp.
5. (networked adj technolog$).mp.

6. (mobile adj phone$).mp.
7. (digital adj media).mp.
8. (internet or cdrom or hypertext or www).mp.
9. (world adj wide adj web).mp.
10. (worldwide adj web).mp.
11. software.mp.
12. "computer uses in education".sh.
13. ("computer assisted learning" or "educational software").sh.
14. information systems/
15. "educational technology".sh.
16. exp "screens (displays)"/
17. “electronic books".sh.
18. "multimedia approach".sh.
19. "computer games".sh.
20. or/1-19
21. (literacy or literacies).mp.
22. "spelling teaching".sh.
23. reading comprehension/
24. reading skills/
25. reading teaching/
26. (learn adj4 english).mp.
27. (learn adj4 read).mp.
28. (learn adj4 reading).mp.
29. (learn adj4 writing).mp.
30. (learn adj4 write).mp.
31. (learn adj4 spell$).mp.
32. (learning adj4 english).mp.
33. (learning adj4 read).mp.
34. (learning adj4 reading).mp.
35. (learning adj4 write).mp.
36. (learning adj4 writing).mp.
37. (learning adj4 spell$).mp.
38. (teach$ adj4 english).mp.
39. (teach$ adj4 read).mp.
40. (teach$ adj4 reading).mp.
41. (teach$ adj4 writing).mp.
42. (teach$ adj4 write).mp.
43. (teach$ adj4 spell$).mp.
44. (develop$ adj4 english).mp.
45. (develop$ adj4 read).mp.
46. (develop$ adj4 reading).mp.
47. (develop$ adj4 writing).mp
48. (develop$ adj4 write).mp.
49. (develop$ adj4 spell$).mp.
50. (reading adj3 disab$).mp.
51. reading ability/
52. reading improvement/
53. spelling/
54. writing skills/
55. reading difficulties/
56. or/21-55
57. computer assisted reading/
58. computer assisted language learning/
59. 20 and 56
60. or/57-59

61. adult literacy/
62. adult basic education/
63. adult basic education.id.
64. higher education.id.
65. professional education.id.
66. or/61-65
67. 60 not 66
68. ("200101" or "200102" or "200103" or "200104" or "200201").up.
69. 67 and 68

1c. PsycINFO

PsycINFO was searched on 19 August 2002, using the WEBSPIRS interface. The database was searched for the updates 2001/4 week 1 to 2002/8 week 1 and 122 records were retrieved. The records were loaded into an Endnote library.

#1 explode 'Computers-' in DE (222 records)
#2 explode 'computer-applications' in de (1274 records)
#3 'computer-games' in de (45 records)
#4 explode 'computer-simulation' in de (751 records)
#5 explode 'computer-software' in de (382 records)
#6 'Electronic-Communication' in DE (231 records)
#7 explode 'information-systems' in de (913 records)
#8 'internet-' in de (771 records)
#9 'word-processing' in de (18 records)
#10 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 (2940 records)
#11 'literacy-' in de (323 records)
#12 'literacy-programs' in de (75 records)
#13 explode 'language-arts-education' in de (307 records)
#14 explode 'reading' in de (399 records)
#15 'reading-development' in de (144 records)
#16 explode 'reading-measures' in de (26 records)
#17 explode 'reading-skills' in de (329 records)
#18 'writing-skills' in de (179 records)
#19 #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 (1394 records)
#20 'computer-assisted-instruction' in de (365 records)
#21 #10 or #20 (2940 records)
#22 #19 and #21 (64 records)
#23 (ict near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)
#24 (information technolog* near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (5 records)
#25 (communication technolog* near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (3 records)
#26 (cal near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)
#27 (cai near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (2 records)
#28 (networked technolog* near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)
#29 (multimodal near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (3 records)
#30 (digital media near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)

#31 (internet near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (42 records)
#32 (cdrom near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)
#33 (hypertext near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (5 records)
#34 (wide web near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (13 records)
#35 (www near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (1 record)
#36 (worldwide web near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (0 records)
#37 (software near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (33 records)
#38 (computer* near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (163 records)
#39 (electronic near (literacy or read or reading or spell or spelling or write or writing)) in ti,ab (23 records)
#40 #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 (236 records)
#41 'adult-development' in de (253 records)
#42 'adult-education' in de (48 records)
#43 'adult-learning' in de (42 records)
#44 (ADULTHOOD in AG:PY) or (AGED in AG:PY) or (MIDDLE-AGE in AG:PY) or (THIRTIES in AG:PY) or (VERY-OLD in AG:PY) or (YOUNG-ADULTHOOD in AG:PY) (45840 records)
#45 #41 or #42 or #43 or #44 (45904 records)
#46 #22 or #40 (258 records)
#47 #46 not #45 (137 records)
#48 #47 and (la='english') (133 records)
#49 (20000809 in UD:PY) or (20000816 in UD:PY) or (20000823 in UD:PY) or (20000830 in UD:PY) or (20000906 in UD:PY) or (20000913 in UD:PY) or (20000920 in UD:PY) or (20000927 in UD:PY) or (20001101 in UD:PY) or (20001108 in UD:PY) or (20001115 in UD:PY) or (20001129 in UD:PY) or (20001206 in UD:PY) or (20001213 in UD:PY) or (20001220 in UD:PY) or (20001227 in UD:PY) or (20010103 in UD:PY) or (20010110 in UD:PY) or (20010117 in UD:PY) or (20010124 in UD:PY) or (20010131 in UD:PY) or (20010207 in UD:PY) or (20010214 in UD:PY) or (20010221 in UD:PY) or (20010228 in UD:PY) or (20010307 in UD:PY) or (20010314 in UD:PY) or (20010321 in UD:PY) or (20010328 in UD:PY) (5963 records)
#50 #48 not #49 (122 records)

1d. Cochrane Library

Issue 2002/2 of the Cochrane Library was searched. Three hundred and thirty-eight records were identified. As it is not possible to limit to a range of update periods, 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 (11) were loaded into an Endnote library.

1. COMPUTER* near LITERACY
2. COMPUTER* near LEARN*
3. COMPUTER* near SPELL*
4. cOMPUTER* near READ*
5. COMPUTER* near WRIT*
6. hYPERMEDIA near LITERACY

7. hypermedia near LEARN*
8. hypermedia near SPELL*
9. hypermedia near READ*
10. hypermedia near WRIT*
11. SYSTEM* near LITERACY
12. system* near LEARN*
13. system* near SPELL*
14. system* near READ*
15. system* near WRIT*tECHNOLOG* near LITERACY
16. tECHNOLOG* near LEARN*
17. tECHNOLOG* near SPELL*
18. tECHNOLOG* near READ*
19. tECHNOLOG* near WRIT*MULTIMEDIA near LITERACY
20. MULTIMEDIA near LEARN*
21. MULTIMEDIA near SPELL*
22. MULTIMEDIA near READ*
23. MULTIMEDIA near WRIT*DISK* near LITERACY
24. DISK* near LEARN*
25. DISK* near SPELL*
26. DISK* near READ*
27. DISK* near WRIT*TELECOMMUNICATION* near LITERACY
28. TELECOMMUNICATION* near LEARN*
29. TELECOMMUNICATION* near SPELL*
30. TELECOMMUNICATION* near READ*
31. TELECOMMUNICATION* near WRIT*VIRTUAL near LITERACY
32. VIRTUAL near LEARN*
33. VIRTUAL near SPELL*
34. VIRTUAL near READ*
35. VIRTUAL near WRIT*WORKSTATION* near LITERACY
36. WORKSTATION* near LEARN*
37. WORKSTATION* near SPELL*
38. WORKSTATION* near READ*
39. WORKSTATION* near WRIT*wide NEAR LITERACY
40. wide near LEARN*
41. wide near SPELL*
42. wide near READ*
43. wide near WRIT*WORLDWIDE near LITERACY
44. WORLDWIDE near LEARN*
45. WORLDWIDE near SPELL*
46. WORLDWIDE near READ*
47. WORLDWIDE near WRIT*WWW near LITERACY
48. WWW near LEARN*
49. WWW near SPELL*
50. WWW near READ*
51. WWW near WRIT*INTERNET near LITERACY
52. INTERNET near LEARN*
53. INTERNET near SPELL*
54. INTERNET near READ*
55. INTERNET near WRIT*ICT near LITERACY
56. ICT near LEARN*
57. ICT near SPELL*
58. ICT near READ*
59. ICT near WRIT*cal near LITERACY
60. cal near LEARN*
61. cal near SPELL*

62. cal near READ*
63. cal near WRIT*cai near LITERACY
64. cai near LEARN*
65. cai near SPELL*
66. cai near READ*
67. cai near WRIT*
68. 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 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or67

1e. Canadian Business and Current Affairs (CBCA) Fulltext Education database

Not available to CRD; not searched for update by CRD.

1f. Dissertation Abstracts

Dissertation Abstracts was searched, using the Dialog Service. The search covered the period July 2001 to July 2002. Forty-five 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.

1 S COMPUTER?
2 S EXPERT()SYSTEM? ?
3 S HYPERMEDIA OR INFORMATION()SYSTEMS
4 S INFORMATION()TECHNOLOGY
5 S MULTIMEDIA OR NATURAL()LANGUAGE()PROCESSING
6 S OPTICAL()DISK? ?
7 S TELECOMMUNICATIONS OR VIRTUAL()REALITY OR WORKSTATION? ?
8 S WORLD()WIDE()WEB OR INTERNET OR WWW
9 S ICT OR CAL OR CAI
10 S LITERACY OR READING OR WRITING
11 S SENTENCES OR SPELLING OR SYNTAX
12 S ADULT? ? OR POSTSECONDARY OR UNIVERSITY OR HIGHER()EDUCATION
13 S S1:S9
14 S S10:S11
15 s s13(3n)s14
16 s S15 NOT S12
17 s S16/ENG
18 s UD='200107':UD='200207'
19 s S17 AND S18

1g. 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 June 2001 to August 2002 week 3. Forty-two 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.

1 S CHILDREN OR ADOLESCENTS
2 S SECONDARY()SCHOOL? ?
3 S ELEMENTARY()SCHOOL? ?
4 S MIDDLE()SCHOOL? ?
5 S SPECIAL()SCHOOL? ?
6 S CHILDHOOD
7 S ELEMENTARY()EDUCATION OR INFANT()SCHOOL? ?
8 S PUBLIC()SCHOOL? ? OR STATE()SCHOOL? ?
9 S COMPUTER?
10 S EXPERT()SYSTEM? ?
11 S HYPERMEDIA OR INFORMATION()SYSTEMS
12 S INFORMATION()TECHNOLOGY
13 S MULTIMEDIA OR NATURAL()LANGUAGE()PROCESSING
14 S OPTICAL()DISK? ?
15 S TELECOMMUNICATIONS OR VIRTUAL()REALITY OR WORKSTATION? ?
16 S WORLD()WIDE()WEB OR INTERNET OR WWW
17 S LITERACY OR READING OR WRITING
18 S SENTENCES OR SPELLING OR SYNTAX
19 S ADULT? ? OR POSTSECONDARY OR UNIVERSITY OR HIGHER()EDUCATION
20 S ICT OR CAL OR CAI
21 S S1:S8
22 S S9:S16 OR S20
23 S S17:S18
24 S S22(3N)S23
25 S S24 NOT S19
26 S S25/ENG
27 S UD>200106
28 S S27 AND S26

1h. SIGLE

The SIGLE database was searched, using the ARC WinSPIRS service. The database was searched from updates January 2001 to June 2002. Three records were retrieved and loaded into an Endnote library.

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. Internet

A selection of key internet sites was searched. Given the largely unstructured nature of web pages it is difficult to restrict searches to material added since a

previous search. Where possible, pages visited previously were revisited and researchers will need to look through the printouts and downloaded files to identify new material.

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

Web page for humanities research. Accessed on 20 August 2002.

Search terms: literacy

The resulting pages of links were printed out for scanning by researchers.

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

Accessed on 20 August 2002. 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 website (http://vtc.ngfl.gov.uk/literacy/index.html). Printed out Research and Reports page (http://vtc.ngfl.gov.uk/literacy/features/research_reports.html).

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

The A-Z of OFSTED Publications list was printed out on 20 August 2002. (http://www.ofsted.gov.uk/public/index.htm). In addition, the list of publications for 2002 was printed out separately.

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

This website was searched on 20 August 2002.

Searched ICT subsections.
Searched Ongoing research database.
Searched Research Findings database, using subject heading assigned by NLT: "Information technology and literacy". Retrieved one record.
Searched Literacy researchers list and printed out.
Printed out a wide range of bibliographies and links pages.

The web pages were saved as files nlt1.htm to nlt12.htm and will need to be scanned for new and relevant information.

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

Accessed the website on 20 August 2002. This website still focuses on case studies, teachers' evaluations of software and publishers' product information. No further information on research evidence was identified.

APPENDIX 2.3 Journals handsearched

All journals were searched for the period July 2001 to October 2002.

Australian Journal of Language and Literacy

English in Australia

English in Aeoteroa

Literacy Learning

Education Media International

Dyslexia

Reading and Writing

Education, Communication and Information

English in Education

Research in the Teaching of English

Journal of Educational Computing Research

Changing English

APPENDIX 2.4: EPPI-Centre educational keywording sheet

V0.9.5 *Bibliographic details and/or unique identifier*……

1. Identification of report
Citation
Contact
Handsearch
Unknown
Electronic database
(Please specify.) ……

2. Status
Published
In press
Unpublished

3. Linked reports
Is this report linked to one or more other reports in such a way that they also report the same study?

Not linked
Linked (Please provide bibliographical details and/or unique identifier.)
……
……
……
……

4. Language (Please specify.)

……

5. In which country/countries was the study carried out? (Please specify.)

……
……
……

6. What is/are the topic focus/foci of the study?
Assessment
Classroom management
Curriculum*
Equal opportunities
Methodology
Organisation and management
Policy
Teacher careers
Teaching and learning
Other (Please specify.)……

***6a Curriculum**
Art
Business studies
Citizenship
Cross-curricular
Design and technology
Environment
General
Geography
Hidden
History
ICT
Literacy – first language
Literacy further languages
Literature
Maths
Music
PSE
Physical education
Religious education
Science
Vocational
Other (Please specify.) ……..

7. Programme name (Please specify.)

……..

8. What is/are the population focus/foci of the study?
Learners*
Senior management
Teaching staff
Non-teaching staff
Other education practitioners
Government
Local education authority officers
Parents
Governors
Other (Please specify.) ……

*8a Age of learners (years)
0-4
5-10
11-16
17-20
21 and over
*8b. Sex of learners
Female only
Male only
Mixed sex

9. What is/are the educational setting(s) of the study?
Community centre
Correctional institution
Government department
Higher education institution
Home
Independent school
Local education authority
Nursery school
Post-compulsory education institution
Primary school
Pupil referral unit
Residential school
Secondary school
Special needs school
Workplace
Other educational setting (Please specify.)…….

10. Which type(s) of study does this report describe?

A. Description
B. Exploration of relationships
C. Evaluation
    a. naturally-occurring
    b. researcher-manipulated
D. Development of methodology
E. Review
    a. Systematic review
    b. Other review

Please state here if keywords have not been applied from any particular category (1-10) and the reason why (e.g. no information provided in the text).

……
……
……
……
……
……
……

APPENDIX 2.5: EPPI English Review Group keywording sheet

KEYWORDS FOR ENDNOTE NO ……

14. Focus of the report **(Tick *all* that apply.)**

literacy	learning	ICT
genre	assessment	CAI/CAL
literacies	dyslexiahypertext	
literature	learning difficulties	moving image
multimodality	learning disabilities	multimedia
reading	motivation	word-processing
spelling	teaching	
writing	ESL/EAL	
	audience comprehension	

15. Type(s) of intervention or non-intervention **(Tick *all* that apply.)**

computer – stand-alone (software)
computer – networked (email)
computer – networked (internet)
mobile phone
other technology _____
(Please specify.)

16. What principal aspect(s) of literacy is the study focused on increasing? **(Tick *all* that apply.)**

16a. psychological aspects
or representations
social representations and/or
cultural/critical representations

16b. writing print and graphical
or pictorial representation
reading print and graphical or
pictorial representations

17. Which outcomes are reported? **(Tick *all* that apply.)**

test results - reading
- writing
- spelling
examination results
motivation/engagement
self-esteem/attitude
quality of writing
increased awareness of process
quality of reading
quality of response to multimedia

18. If study type in question 10 is c.b. (researcher-manipulated), is it

A. RCT
B. Trial
C. Other?

KEYWORDER …… DATE ……

APPENDIX 2.6: Glossary for review-specific keywords

Literacy
The ability to read and write.

Genre
Basically, a type or category of text. In the Australian tradition, it means 'text-type'. In the North American sociological tradition, it means identifiable patterns of 'social action' grounded in texts.

Literacies
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 review. 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. Both these expansions of the narrow term 'literacy' can be termed 'literacies'.

Literature
Fictional, dramatic or poetic texts.

Multimodality
The use of more than one mode of communication to convey 'information'. All texts, in a sense, are multimodal in that printed writing is both visual and verbal. Multimodality is usually reserved for the combination of word and image and/or sound conveyed via the computer screen.

Reading
The act of bringing meaning to print.

Spelling
Orthographic representation of phonemes, morphemes and words.

Writing
This term should be reserved for papers that study the impact of ICT on general writing skills and capabilities (for example, the structure and expression of compositions).

ICT
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.

CAI/CAL
'Computer-assisted instruction' and 'computer-assisted learning'. The former tends to be associated with self-supporting computer programs which replace the teacher, rather than complementing him/her.

Hypertext
Computer-readable text which allows for extensive cross-referencing, particularly 'vertically'; that is, it is possible to conceive of and present text in vertical layers rather than conventionally, in a horizontal plane.

Moving image
Film, video, animation.

Multimedia
The use of more than one medium of communication to convey information. Whereas multimodality refers to the combination of more than one mode of communication (e.g. the verbal and visual), multimedia is a more technical term referring to a range of media which can convey such modes of communication.

Word-processing
The composition of verbal language on screen, usually on computer and in substantial form – as opposed to 'texting'.

Learning
The transformation from one state of personal knowledge to another.

Assessment
The measurement of learning performance, either 'summative' (at the end of a process of learning) or 'formative' (during the process of learning).

Dyslexia
Difficulty with learning to read or spell, arising from problems with grapho-phonemic equivalence. Also known as 'specific learning difficulties'.

Learning difficulties
These are difficulties with learning encountered by any children or young people at any age, and are associated with a variety of barriers to learning that may be temporary and which may be overcome by teaching strategies, appropriate curricula, etc.

Learning disabilities
These are more profound and developed difficulties with learning encountered by children and young people at any age, and are associated with a variety of barriers to learning that are usually more permanent.

Motivation
The impulse and/or desire to learn.

Teaching
Teacher-centred strategies for encouraging, eliciting and developing learning in pupils and students.

ESL/EAL
'English as a second language' (as opposed to English as a foreign language) refers to the language as learnt and taught by people for whom English is not a first language or mother tongue, but is acquired (often with much teaching help) as a second language with distinct functions in society. 'English as an additional language' is now the preferred term, as it implies that English may be learnt not only as a second language, but as a third or fourth language in a culture.

Audience
This term can refer to an audience of one, as in a single respondent or listener, up to an audience of inestimable size via the internet.

Comprehension
Understood by psychologists as a key activity in learning to read, and complementing 'decoding' of printed text. Understood by English teachers as a now outmoded form of textual analysis and appreciation in which text is subjected to a series of questions to elicit understanding.

APPENDIX 4.1: Characteristics of studies included in the in-depth review

Author, date and country	*Study type*	*Aim*	*What was studied?*	*How was it studied?*	*Findings and comments*
Decosta 1992 USA	Description	1. To describe an 'emerging computer-connected early writing program' (p 17) 2. To 'share examples of children's writing' (p 25) 3. To 'discuss their sociological implications' (p17)	Subjects were children who were 'predominantly Italian and East European in heritage: about one third…are black' (p 17) What exactly is examined is unclear, but, at a general level, the study addresses how the CAI work was integrated into the general teaching of reading and writing, and what could be inferred from extracts of children's texts. Sample: six classes (two kindergarten and four first grade) use the CAI at any one time. The actual sample size is not stated. Ages of the sample are from 5 to 10. Mixed sex. Data collected involved details of the teaching procedure, informal observation of classes and children's texts. The latter seem to define the sample.	Students collaborated on producing texts using the CAI. They wrote on matters relating to their private lives. They were allowed to revise their work. Data (children's texts) were analysed through common-sense inferences concerning sociological aspects (undefined) of their writing.	No statistical methods were reported as being used, not even for the claimed increases in reading and writing skills. The authors admit that using the computer program may not have contributed greatly (p 25), but that it did help in removing the focus on form, allowing their attention on the content of their writing to be increased. The lack of a clear research design and any quantitative details make it hard to interpret in a consistent way the authors' comments about the data. Teacher's role noted as becoming a facilitator.
Lin *et al.* 1991 USA	Evaluation: Researcher-manipulated. RCT	To assess the differential effects of critical features of computer-assisted instruction (versus a pen-and-paper approach) with respect to the automatisation of word - recognition skills by 'mildly mentally handicapped' and 'non-handicapped' learners	Sample: 93 'non-handicapped' second grade students (mean age 7.81 yr), and 'mildly mentally handicapped' students from various grades (mean age 8.86 yr) were randomly allocated to instructional medium (CAI or pen and paper). Intervention: CAI condition: 'Word Attack software program employed to teach word- recognition skills (presentation and practice phases) Control: Pen and paper condition: Flashcards and worksheets employed to	RCT (individual) Pre- and post-test data	Accuracy of scores ('non-handicapped'): No significant differences between the groups Accuracy scores ('mildly mentally handicapped'): borderline significant positive effect for control Accuracy scores (total): significant positive effect for control Response times ('non-handicapped'): positive and significant effect for intervention Response times ('mildly mentally handicapped'): positive and borderline significant effect for intervention

Author, date and country	*Study type*	*Aim*	*What was studied?*	*How was it studied?*	*Findings and comments*
			teach word-recognition skills (presentation and practice phases) Outcome measurements: accuracy; response times		
Nwogu and Nwogu 1992 UK	Description Evaluation, researcher-manipulated, of teachers' and learners' opinions	1. Generally, to investigate 'what goes on in the CALL classroom' 2. To observe 'the use of the computer in second language teaching in a secondary school in the city of Birmingham' (UK) (p 74) 3. Specifically, to 'study how the resources available for CALL are being utilised in the school studied' 4. To study 'what constraints, if any emanate from using them by both teachers and pupils' (p 74)	Ten secondary pupils (11 to 16 year-olds) extracted from classes into one or more ESL classes. One ESL teacher was observed. Data are reported from five other schools visited as part of the preparation for the study. In one school, the study was concerned to establish: 1. the quantity of available computer hardware 2. the nature of available software 3. the types of teaching/learning activities these were used for 4. the appropriateness of the software for these activities and these learners' needs 5. the amount of access to computers (for ESL) given to learners	The study describes the facilities and CALL programme in one school. Observations were made across a four-month period, but development over time was not explored. The interview and questionnaire were administered at the end of four months.	Results are presented as running text, with no tables or copies of questionnaire or interview schedule. Researchers conclude that no impact is possible without hardware, access time (one hour per month was available to students), software that fitted class teaching and could be adapted to it. Also, ESL staff need to be trained appropriately. All 10 students thought ICT had contributed immensely to improving their competence in English. They preferred reading and writing ICT work to classwork, finding it less boring. They wanted to have games as part of the software.
Parr 1997 New Zealand	Evaluation of CAI program (Successmaker) Naturally-occurring	1. To study from teachers attitudes to CAI, relationship between computer work and the curriculum, use of diagnostic information from the program, perceived student progress, perceived changes in student attitudes and behaviour 2. From students: views	Unclear exactly how many students or how many groups. Table 2 (p 45) lists results for 11 groups of 11 to 16 year-olds, but some are not referred to in the text. The number of ESOL students is given as 29 (p 41) and the number of non-ESOL students is given as 379 plus 15 SEN (p 40) although ethnicity data given in the paper suggest that a Maori group is not ESL.	Observations, interviews, self-report, performance data, measures of time spent on program, rate of gain using 'Strands' courses, national PAT reading scores	Teachers report: ICT eased role of the teacher. This was seen, although several disengaged. Students had made progress. M/c group initially diagnosed low. They learned fast so had high gain scores, but no long-term effect. Increased reading scores; gender effect significant, girls gained more. Writing quality increased comparing mean

Author, date and country	*Study type*	*Aim*	*What was studied?*	*How was it studied?*	*Findings and comments*
		on the program, perceived progress, post-program 'feelings as opposed to when they started using the program' (p 41)			post-test scores. Student opinion mixed. 70% felt had made good progress; 21/63 found Successmaker 'boring'; 26 motivated by work style; 10 liked absence of writing; 10 liked being in control (not 'told off'). No language or ethnicity effect reported.
Silver and Repa 1993 USA	Evaluation, researcher-manipulated	1. General aim is to identify under-utilised resources in schools and make them accessible to the students in the study. 2. Specific aim is to see if ESL students in an urban high school improve the quality of their writing and their self-esteem if they make use of word-processing.	Four intact classes were used, but these were randomly assigned to control or experimental groups (implying that there were two groups to each condition).	The design was quasi-experimental pre-test/post-test. Writing samples were marked holistically at the start and at the end of the 13-week intervention.	All writing samples were pen-and-paper based except that experimental groups also produced word-processed, computer-composed samples of writing (i.e. experimental groups had two post-tests). Self-esteem showed no increase but positive attitudes to writing developed in the experimental groups. Anecdotal comments (no data cited) made to the effect that ICT teacher became a facilitator.
Sinatra *et al.* 1994 USA	Evaluation, researcher-manipulated	1. To determine 'if an integrated use of computers with semantic mapping, reading and writing would be more effective [with at-risk 4th grade students] for reading and writing success for Chapter 1 approaches which did not use the computer-software mapping	260 9 to 10 year-old students in six schools, with 20 students in control group and 160 in experimental groups and 80 in control then experimental ½ year. Unclear which schools had which sub-groupings. Gender balance not given. Six teachers The study aimed to measure the quality of text produced by students, their reading	Treatment differed by two factors: the control group did not use computers and did not use semantic mapping (p104). It is unclear whether any instruction or practice re narrative took place. Pre-intervention reading test to isolate population.	Post-test writing scores higher for both control and experimental groups ICT groups improved more than pen/paper, using semantic mapping for stories. Gains were uneven across groups. Gain depended upon teacher. No gender effect apparent for writing, but the ICT girls had a better attitude towards writing (note: contrary to Silver's findings).

Author, date and country	*Study type*	*Aim*	*What was studied?*	*How was it studied?*	*Findings and comments*
		approach' (p 94) 2. '…to assess the attitude of the teachers towards the use of computers and to measure attitudes towards writing of a sampling of fourth grade students' (p 94)	skills and attitudes towards writing (post-test only). Teacher opinions were also investigated.	Pre-and post-intervention writing samples. Student attitude questionnaire. Teacher attitudes were sought by questionnaire before the program about their experience with computers and afterwards by questionnaire and interview about their impression of the instruction and the program.	
Van Haalen and Bright 1993 USA	Evaluation, researcher-manipulated	To examine whether bilingual students access a broader range of cognitive and learning skills than monolingual students and hence perform at a 'higher' or more advanced level when writing text with a word-processor	Two pre-existing groups of 42 students, one monolingual (English, n=20) and one bilingual (Spanish/English, n=22) Both groups given the control condition twice then the intervention condition twice, thus four assignments	The amount of revisions and holistic writing quality were compared between the two groups. Means and sd of all variables were presented in tabular form. (M)ANCOVA/ ANOVA results given in tables. Revision differences and frequencies of revision types between the two groups were given as a chart.	Control *versus* experimental condition: More revisions in pen-and-paper groups. Females made more revisions than males. Most pen-and-paper revisions made at word level, then surface, clause and sentence. But WP revisions most frequent at surface level. Keyboarding skills significant in predicting number of revisions. Computer not used to experiment with text-manipulation. (This equates with Daiute's findings). Monolingual *versus* bilingual groups: Monolinguals made significantly more surface revisions but bilinguals made more phrase level revisions. Gender x language interaction for total

Author, date and country	*Study type*	*Aim*	*What was studied?*	*How was it studied?*	*Findings and comments*
					revisions made Few differences between the groups for holistic scores, except when keyboarding skills factored in, when holistic scores increased for bilinguals Gender not significant here
Williams and Williams 2000 USA	Evaluation, researcher-manipulated	To '…determine whether the integration of reading with computer will improve the (sic) ESL student reading skills' (p 98)	One group was studied. A separate class for ESL was created. N=27 at first; 21 lasted the course. Ages 11 to 16. In one urban secondary school. 9 males, 12 females. One Mexican, one Indian, one Russian and 18 East Africans.	The intervention was provided for one semester. It seemed to be a Computer Application/reading course that was part of a Business Studies course. Main problem was a very poor comprehension of technical words and texts as a whole.	Before the intervention, '100% of the ESL students could not do the work'. The accuracy rate in terms of transcription by students of sentences with 10+ words was measured at the end. 75% increased ability to transcribe words, but PC may not have been cause of this rise.