

Understanding the past – illuminating the future

This is the report of a project funded by the British Educational Communications and Technology Research Agency (Becta) to identify the key – but forgotten - ICT research projects in the UK between 1980 and 1999 and review the contribution that these projects can make in informing the current Becta research agenda and making future research more efficient. It is reproduced here by permission of Becta.

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Those who ignore the lessons of history are doomed to perish by them (George Santayana)

1. Introduction

Many - perhaps the majority – of current learning technologists fail to take advantage of the lessons of earlier projects. They do not link what went before with what is now. This may be because of the excitement of working with leading edge technology so that there is no time to lose. Perhaps it is because they are unused to the effects of disruptive technologies. It may also be because the research and development is driven, not by learning technologists but by information technologists who are unaware of what has gone before.

The evidence to support these assertions can be found by looking at the literature searches described in published papers which failed to find relevant earlier work and by talking to typical project staff at conferences. Time and time again well informed researchers appear to be unaware of projects undertaken before 2000. Indeed, in our own research for this project we were unable to find references to some projects from this era in our websearches – *even though we knew details such as the project titles and the names of the key researchers*. An example illustrates this point. Another paper in this special issue describes *Project Author*. This was a significant initiative to train staff for industry in the design skills needed for what we now call e-learning. We were unable to find a single reference on the Web to this project. If anyone reading this paper has more success than we would be delighted to be corrected!

It is almost as if our field started in the late 1990's and that nothing of importance happened before that time. Yet, the two decades from 1980-1999 encompass a great deal of UK research and development in the use of technology in education and training. There were major government funded programmes into the use of microcomputers in primary, secondary and higher education, the use of expert systems, and technology based training. Industry too, researched the effective use of newly developed technologies.

If we fail to learn from history of ICT in education and work-based learning we are condemned to repeat it. We will continue to cycle round and round the innovation cycle, unaware of the lessons from which we could learn, making relatively little progress. The consequences of this failure are not only measured in poor progress but in the costs of projects which do not deliver their full potential.

This work is based on the premise that we need to identify the relevant, key projects from, say 1980 to 1999, and to make their outcomes accessible to today's practitioners. And we need to do this soon, while we still have access to the key players from that period. Some of them have already retired (some unfortunately have already died), library holdings are being reduced and reports discarded, and memories fade. The costs of retrieving this information and making it accessible are probably less than the true costs of a single research project. We only have to prevent one new project from failing in order to recover our investment. The aim of the project was to enable The British Educational Communication and Technology Agency (Becta) and the UK ICT research community in general to build on what has gone before rather than to reinvent it, and thus achieve more from their research budget. In addition to a report which would be available in print as well as on the web, the intention is that as much as possible of the information gathered during

the project will be collated and made available on the Becta website.

Not all of the projects carried out between 1980 and 2000 are relevant and retrieving information on everything would be prohibitively expensive. The search was therefore informed by the current agenda for ICT in learning – and the likely future agenda over the next five years. Where we encountered work that was considered to be important but not immediately relevant, it was book-marked so that it can be investigated further if necessary at a later date.

1.1 Cycles of learning technology

If we carried out a quick poll on the state of ICT in education and training at the end of 2007 we would get a range of views. Some would extol its success, but others would say that it has still failed to live up to its promise – although the breakthrough is probably near. If we look back through recent history – say the last 40 years – there is a ring of familiarity in these views. ICT in education and training seems to have been on the edge of a breakthrough, just reaching critical mass, starting to deliver real benefits, for all of that time. In part it is because we keep raising our expectations as technology become more capable. We are continually dissatisfied with what we have achieved and we strive to do better by pushing the technology further. In part it is because we fail to learn from what has gone before. The thing that is consistent is that history teaches us that we don't learn from the past.

Those who have been working in the field for a long time recognise repetitive cycles of innovation. As illustrated in Figure 1, the adoption of a typical innovation starts slowly, then picks up pace until the market is saturated at which point the curve levels out – then starts to decay as users find and change to other solutions.

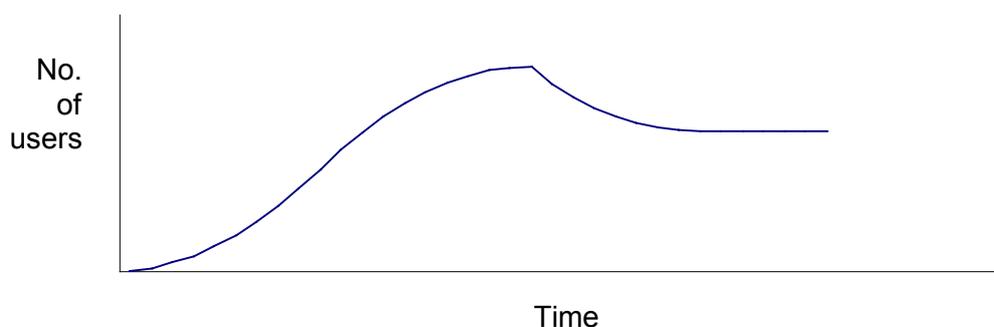


Figure 1: A simplified innovation adoption curve

In the case of ICT in education and training this process has been relatively short. Each new advance in technology produces a surge of activity with research and development into the possibilities of using the technology within learning, and this gives rise to the 'New Technology.' The surge of activity attracts a group of enthusiasts who extol the features of the innovation and a new cadre of researchers eager to explore its potential. Speed is important here, and in the rush, learning design at both the overall and detailed level tends to be poor, squeezed out because there is insufficient time to do it properly. Consequently the new learning may look good superficially but misses its objectives, and consequently gets a poor image because it doesn't deliver the promise. The full benefit of the new technology is never achieved because the good examples are submerged under the morass of the mediocre.

But often before the technology matures, it is overtaken by a new innovation. This attracts a new group of enthusiasts and researchers. The earlier groups are associated with the older technology, and now there is something newer and better. Too often the researchers and their experience fade with the technology. And so we go round the cycle again.

One consequence is that new advances in technology are often driven by a group of people who have not been closely associated with earlier technologies. Seabrook and Grigg (2000) found that in the commercial sector, 27% of those involved in developing technology based training had less than two years experience in the field, and well over half had less than five years experience. In one instance a large UK-based 'Do it Yourself' company recently launched e-learning to train its staff, but appeared unaware that in the late 1980s-early 1990s it was one of the national organisations leading innovative use of technology based training. Subjectively, it appears that a similar situation pertains in many educational organisations.

Corporate memory can be lost in a relatively short time, and with it the lessons learned in previous uses of learning technology. The lack of organisational memory is compounded when a new use of technology is treated as a special project. These project teams tend to be very interested in innovation and getting things up and running, but once the project is launched the team is dispersed and people return to other positions. Important issues such as evaluation and maintenance are not given sufficient priority.

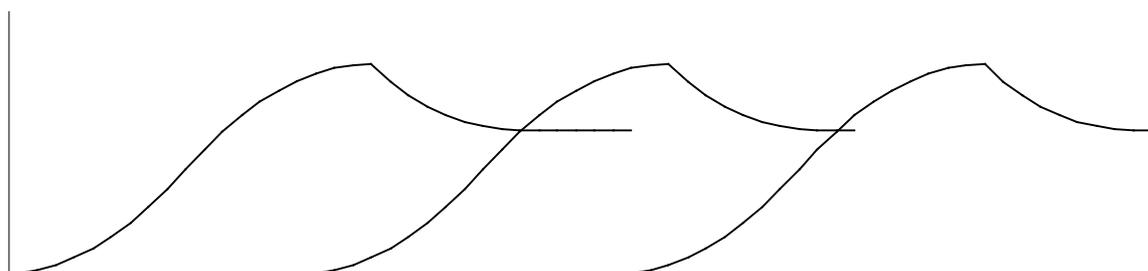


Figure 2: Successive cycles of adoption

In practice, this cycle is not as simple as it looks. Some innovations reflect progressive change in the technology - an improvement on what already exists. For example, in the 1980s to 1990s there were several progressive changes in the way that we could incorporate video in learning sequences, from videotape and cassette, through videodisc (both laser and capacitative) and CD-I and then to now-familiar CD. Disruptive innovations come from the introduction of radically new technology, such as the introduction into learning in the 1950s of the computer itself, the advent of the Internet, mobile computing, and most recently web 2.0 which is enabling a flood of constructivist learning in education. Throughout this, the most astute learning technologists have realised that it is wasteful to cast earlier technologies to the dustbin of history if they are still fit for purpose and can be used effectively in a blend of learning.

1.2 A changing agenda

It is inevitable that any research agenda is a dynamic thing; as our understanding moves on so the agenda must develop. In this case the project was looking at outcomes from the research agenda 7 to 27 years ago and seeking those with contemporary relevance. This approach can be – and was – questioned. One of the members of the Sage Group, David Hawkrige observed that as the technology moves on the context changes and so the

reports of research findings are inherently ephemeral.

“It’s not that we’re re-inventing the wheel all the time. Rather we’re deploying new technology to address old educational problems. The Web and the Internet didn’t feature at all in the research of that period ... of course. And Web 2.0 applications don’t feature in research done in 2005...

“The great questions remain largely unanswered despite the changing context of new technologies: How do we or the learners decide what to learn and why, and when, where and how to learn it? How and by whom can this learning be assessed? The case can perhaps be made for recent studies ignoring some of the lessons of earlier ones in respect of educational design and evaluation.

“Many of the recent papers ... focus on applying new technologies to the task of improving learning. They report research projects that are, inevitably, limited in scope, in respect of either the content being learned, or the group of learners, or the technology itself.

“Another important but less obvious reason is that the ideology and paradigms change too. In 1980 social constructivism was just emerging as an ideology in education. The quasi-scientific research paradigm adopted during the days of behaviourism was losing ground fast, particularly in the UK. Attempts at creating evidence-based educational technology cannot use the same paradigm as evidence-based medicine (which has problems galore in using that experimental paradigm, anyway). Controlled trials of ‘technology pills’ to determine their value simply do not exist, for very good reasons. Findings, such as they were, from so-called experimental studies in the 1980s don’t count for much today because they were often based on a paradigm now rejected as unsound. Findings of no significant difference between experimental and control groups at best failed to reject the null hypothesis (that there was no significant difference) and at worst failed to control for several variables, such as the teacher, the content, the mode of assessment, and so on.” (Hawkrige, 2007 personal communication)

Despite these reservations that the context changes as technology moves on, there are some research findings that are applicable to the newer technologies and the current research agenda. For example, the Apple Newton technology has long been superseded but the findings from the research carried out on workplace assessment with British Rail and Aer Lingus in in late 1990s (Johnson, Rushby and MacLean, 2000; Rushby and Fairbrother, 1995; Rushby, 1996) are still relevant to assessment today and contribute to the Balanced Scorecard (see 4.3 in table 1).

2. Project methodology

The work was divided into a number of inter-dependent workpackages as shown in figure 3.

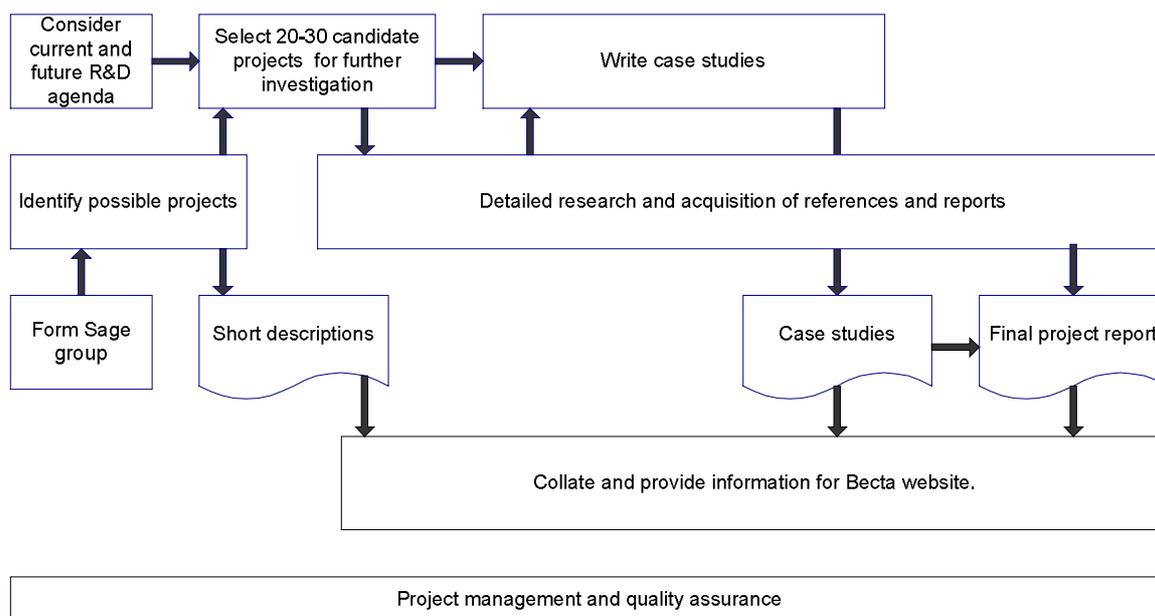


Figure 3: The project methodology

A key component of the project was the group of experts known as the ‘Sage Group.’ As the name implies, they were invited to join the project team because of their knowledge and experience of learning technologies during the 1980s and 90s. These were people whose judgement we respected and who were immensely helpful in helping us to identify the key projects and to locate documentary evidence.

There were initially two parallel lines of enquiry: to understand the current Becta research agenda so that we could focus on projects that could make a useful contribution, and to start work on identifying possible projects for inclusion in the case studies and report.

The Becta research agenda is driven by the balanced scorecard shown in Table 1. This has evolved since the project was first devised and the most recent version from the delivery plan for Harnessing Technology (Becta, 2006) is shown here.

<p>Capability and capacity of the workforce, providers and learners</p> <p>1.1 Leaders have the knowledge and skills to ensure technology for learning can be harnessed for the benefit of learners</p> <p>1.2 Institutions and providers plan and manage technology for learning effectively and sustainably</p> <p>1.3 Practitioners exploit technology consistently to offer engaging and effective learning experiences</p> <p>1.4 Practitioners, parent and learners can share and use information and data effectively for the benefit of learners</p> <p>1.5 Improved learner capability in using technology to support their learning</p> <p>1.6 There is a greater choice in learning opportunities and modes for all learners</p>	<p>Outcomes and benefits for learners and children</p> <p>3.1 There is a greater choice in learning opportunities and modes for all learners</p> <p>3.2 Learners have increased motivation for engagement in learning</p> <p>3.3 Fewer learners underperform or fail to succeed in education</p> <p>3.4 An improvement in the quality of learning provision is accelerated</p> <p>3.5 There is improved child safety and child protection</p>
<p>Fit for purpose technology and systems</p> <p>2.1 All learners and practitioners have access to the appropriate technology and digital resources they need for learning</p> <p>2.2 Every learner has a personalised learning space to enable them to learn when and where they choose</p> <p>2.3 Technology-enabled learning environments are secure, supported and interoperable</p> <p>2.4 There is a dynamic, vibrant and responsive technology market that can meet the needs of the system</p>	<p>Efficiency, effectiveness and value for money across the system</p> <p>4.1 Learning providers collaborate and share information and resources</p> <p>4.2 The management and administration of learning and institutions is more efficient</p> <p>4.3 There is a greater level of effective, learner focused assessment for learning</p> <p>4.4 Practitioners collaborate and share good practice and learning resources</p> <p>4.5 There is good use of information to support learner transition between institutions and sectors</p>

Table 1: Becta's balanced scorecard

From these aspirations we produced an expanded table (Table 4) that set out the kinds of evidence that we believed would contribute to the agenda, and used those as criteria for selecting key projects. The task of identifying possible projects for inclusion was addressed from three directions. These were a literature search, asking the Sage Group, and locating various archives of materials.

2.1 The initial literature search

Firstly, we looked at the tables of contents for some of the key journals and conference proceedings during that period. These included

- a. The *British Journal of Educational Technology*. BJET is available online from Blackwell Synergy at www.blackwell-synergy.com. A user account is required to access the full text of digitised articles, but the abstracts and references are available free of charge. A recent project has scanned an all of the earlier issues so that the entire run is now available.
- b. Programmed Learning and Educational Technology. *PLET* was published under its

original title until 1988 (Volume 25) but then changed its name to *Educational and Training Technology International (ETTI)*. It retained this title for six years from 1989 to 1994 (Volumes 26 to 31) and then changed its name again in 1995 to *Innovations in Education and Training International*. In 2001 there was yet another name change to *Innovations in Education and Teaching International*. The contents pages for *PLET* are available online from Informaworld at:

<http://www.informaworld.com/smpp/title~content=t713685495>

- c. Interactive Learning International. This journal was published by Wiley between 1984 and 1992. Although the journal published a significant number of important accounts of learning with advanced technologies in the UK and North America it has not yet been digitised.
- d. Journal of Computer Mediated Communication. JCMC is published by Indiana University and is available on the web at <http://jcmc.indiana.edu/issues.html> or from Blackwell Publishing at <http://www.blackwell-synergy.com/loi/JCMC>
- e. Journal of Computer Assisted Learning. Issues of JCAL published since 1997 (but not those published earlier) are available from Blackwell Synergy at <http://www.blackwell-synergy.com/loi/jca>
- f. Aspects of Educational Technology. This series formed the proceedings of the annual conference of the Association for Programmes Learning and Educational Technology (APLET).

There were many other journals that we could have included: inevitably our search was limited by time and other resources and so we focused on those that reported work from the UK. The list of tables of contents was helpful in identifying potential projects for more detailed study and as a quick reference to some of the relevant published literature.

It is clear from this list that the major publishers are making strong efforts to make the earlier versions of their journals more accessible through the web. The costs of scanning and digitisation are justified by the commercial benefits of offering a more comprehensive coverage. However, the scanned text is not always searchable and the citations are not always linked into the web of knowledge that enables researchers to track lines of research across different authors.

2.2 The Sage Group

Next we asked the members of the Sage Group for their input:

- a. What do you think are the most significant learning technology projects of that period – and why?
- b. How do the findings contribute to the current research agenda?
- c. Where were the finding published and do you know where we can get a copy?

2.3 The archives

The third line of enquiry was to raid the physical archives of some of those who had been working in the field at the time – including the authors' own collections. The quantity of off-prints and printed reports that we obtained was remarkable and it took several weeks to catalogue and make some order from the material. In particular this yielded project briefs

and reports from the Training Enterprise and Education Directorate (TEED) based in Moorfoot, and from the EU-funded projects Delta (Developing European Learning through Technological Advance) and RACE (Research into Advanced Communications in Europe). We had originally hoped to scan in much of this material but the quantities were much greater than anticipated and we were only able to digitise a small – but hopefully relevant – fraction.

In particular we were given access to a structured database containing 50 reports of projects undertaken for the Department for Education and Employment concerning Open and Flexible Learning and Technology Based Training (May 1999). While this is not a comprehensive list (there were far more than 50 projects!), the list in Table 2 gives a flavour of the wide scope of this unit.

To assist in managing the wealth of information on the TEED projects, we developed a second hyperlinked database of project details and descriptions. The intention is that this will be made available through the Becta website in due course. It is clear from this database that a great deal of research into open and distance learning was carried out under the aegis of TEED and the experience gained was extensively documented in a series of reports.

Few of the publications from the Department for Education and Employment remain in libraries. The library at Moorfoot (together with the extensive collection of demonstration material and equipment) was dismantled when the space was required for other purposes. A selection of the reports were taken by a university library but this holding too has been diluted over time.

A similar fate befell the CEDAR Collection (Computers in Education as a Resource) at Imperial College. CEDAR was established in 1979 at the end of the National Development Programme in Computer Assisted Learning (Hooper, 1977) and operated an international information centre on computer assisted learning and training. It built up an extensive collection of books and reports which were transferred to the College library which the project came to an end in 1984. Inevitably, demands on space led to the collection being destroyed: only a few of the most important pieces were saved.

The National Interactive Video Centre was created by the National Council for Educational Technology and acted as a focus for developing and disseminating educational and training applications of video disc technology. When the Centre closed in the 1990s, its collection was transferred to Essex where it formed the nucleus of the National Archive for Educational Computing (see <http://www.naec.org.uk/>). Much of the archive was gathered in the years 1990 - 2006 by Prof Stephen Heppell and Richard Millwood. It is now in storage looking for a permanent home.

In the United States the Education Resources Information Center (ERIC) at Syracuse has been more successful in surviving over the years. With sponsorship from the U.S. Department of Education, Institute of Education Sciences (IES) ERIC provides free access to more than 1.2 million bibliographic records of journal articles and other education-related materials and, if available, includes links to full text (see <http://www.eric.ed.gov/>).

3. Findings

The amount of material discovered, or uncovered, or recovered, by this project has been vast. Many projects were carried out with direct relevance to today's technology and culture, provided time and effort is made to extract the information that can be used, and this information can be used to start a new project using today's technology because people still ultimately learn in the same way. The way humans have learned for thousands of years. The mistake – if there is one – is to think that because the technology has changed then people are learning in a new way.

“Bernard of Chartres used to say that we are like dwarfs on the shoulders of giants, so that we can see more than they, and things at a greater distance, not by virtue of any sharpness of sight on our part, or any physical distinction, but because we are carried high and raised up by their giant size.” John of Salisbury 1159, *Metalogicon*

By using relevant information from the projects from the 1980s and 1990s current research projects can start from an established point rather than repeating work already done and coming to similar, if not the same conclusion. This project was conceived when we encountered two current projects had not found any reference to previous work where such a relevant topic had been explored and reported and we suspect that there are many others. These relate to Workplace assessment in hostile environments (1993) and Learning credit cards (1990). Both are found in the case studies in the Appendix to this report.

Several of the Sage Group remarked that during the 1980s in particular there was an explosion of creativity producing computer based learning making use of technology advances, many of which are difficult to imagine now – such as the change from two colour, to seven colour to 256 colours to 16 million colours; the move from character graphics to bitmap graphics; coupled with increasing resolution, and falling costs. So in a period of about 6 years learning technology had moved from text and graphics constructed from various characters (remember ASCII characters?) to an ability to show moving video at a price that was affordable for many. There were also lessons learned about the use of colour, graphics, pace, and screen layout during this time which assist the learning. Those lessons still apply even though the technical capability has improved immensely.

What is interesting is that, where the learning design is good, people appear to have learned using CBT/CBL irrespective of the richness and technical quality of the presentation on screen. It was during this time of great technological change the emphasis on learning design became less significant and its importance ‘lost out’ to technology. Just as we have lost the research lessons from the 1980s and 90s, that generation forgot the lessons and techniques from the programmed learning experts.

Constraints in the design of learning in the early 1980s forced developers to be inventive with the options they had. The plethora of visual and auditory ways of conveying a message which have become available since then appears to have taken precedence over the learning design underpinning the e-learning in some cases. Some current corporate e-learning developers have re-discovered that simplicity in presentation of material conveys the learning just as well as e-learning rich in graphics, video and animations.

Since the 1980s, e-learning has been referred to as Martini learning – anytime, anyplace, anywhere and the emphasis is on the flexibility of the technology. However another aspect

of CBT important in the 1980s and 1990s was the idea of 'One-to-One' learning. Courses were designed to flow as if you had a tutor/trainer with you, rather than an electronic box. This meant answer analysis was far more complex and feedback more comprehensive than is often found now. It was not unusual for a four option multiple choice question to have 10 or more feedback options, allowing learners to have more than one attempt at the question and never reading or hearing the same feedback. This is now very rare. Having complex answer analysis encourages the learners and simultaneously allows them to feel the elearning is actually personalised. Also more common in the 1980s and 1990s was a wider range of question types, adding variety and challenge to both the learners and programmers. Today question types available tend to be restricted, unfortunately in some cases to just True/False and multiple choice, a restriction originally imposed by the web but not applicable now. Many of our Sage group remarked on these changes.

Other projects achieved a great deal with the technology available at the time that has since been refined and evolved. Networks were used, mostly conveying data rather than personal communications, but innovative use was made of these – for example the Scottish Police College with NCC developed very realistic simulation training for crowd control using a network and the lessons can be useful for those developing similar applications today (DfEE, 1996). The information gained from games and VR simulations does not negate other lessons from earlier less technologically advanced simulations.

Another change with the rapid evolution from CAL to elearning has been the apparent urge to condense elearning to a 'one size fits all'. Before any CBT/CAL solution was started the designers considered the learning situation they had to address. Not all problems are solved by providing learning: some require other approaches. Secondly developers matched the technology to the learning requirements, using the software and hardware available to address the situation with maximum benefit to the learners and their organisation. Unfortunately this process now often appears to be reversed with the technology driving the learning.

Great attention was paid to soft factors, such as motivation of learners and how the e-learning is going to be used; those implementation issues which can make or break a project ranging from why anyone would want to do the learning to questions about whether they can they use the learning once they have done it, what will be the result (such as better grades, better pay, a qualification), and even how do they find out the learning exists and how to access it. Current drives to keep costs down have restricted the chance for many of these types of questions to be addressed and this probably contributes to un-met expectations of various projects.

The question of why the promise shown in the 1980s of artificial intelligence and its associated technologies was never realised in education and training is discussed in detail by David Welham (2008). He suggests one reason has been that the focus of technology based training research has moved rapidly towards exploring the capabilities of the internet. "The advent of the internet and the ability to deliver training and learning to a wider populace has been accompanied by restrictions of bandwidth that have mitigated against the development of AI type programmes which by their nature are bandwidth intensive." If this is so, then it is an example of cyclic innovation where the potential benefits of an earlier technology are lost in the enthusiasm to embrace the new.

More encouraging is Welham's suggestion "that some of the techniques that were originally considered to be AI are now themselves part of the learning mix. Natural language processing is now not considered to be particularly innovative and expert systems in

various guises are embedded in many current e-learning offerings. Embedded and context sensitive help, so revolutionary in times gone by, are now a common requirement of learning programmes. .. AI, as it was then known, has crept up on the world of learning by stealth and is secretly alive and well but embedded in the mainstream.”

But perhaps the major reason for the relative failure of AI to gain a foothold in the training world is cost. If adequate learning can be achieved by cheaper alternatives then there is no business justification, either in education or training, for relatively costly AI techniques. “It is the use of AI, in its varied forms, in appropriate circumstances’ to ‘enhance and enrich’ training systems that seems to be the role that has emerged after all the years of research.”

Despite the current lack of visible impact it is possible that AI techniques will be incorporated in the new generation of web tools to make information dissemination and retrieval more effective. “If this proves to be the case then AI will have had a truly major impact on learning for the future though not the one envisaged by the researchers of the 1980’s and 1990’s” (Welham, 2008).

So many of the projects within those two decades – as now – can be seen in retrospect as isolated, in that they did not have an explicit plan for the future. One of the reasons for the impact of the National Development Programme in Computer Assisted Learning was that every project funded by the Programme was required to have a robust plan for assimilation and dissemination (Hooper, 1977). The Programme referred to this as ‘getting into the brickwork of the institution.’ The consequence was that most of the projects continued well beyond the end of the external funding, and their findings were assimilated into the body of knowledge of computer assisted learning.

In the training arena, Esdale (2007) has identified organisational conservatism as a major reason for project results being lost - in this case through apathy. He cites a project carried out by Wicat for on the job training and assessment for aircraft maintenance staff using personal digital assistants (PDAs). “The area we were using it for, commercial aircraft maintenance, is an extremely conservative discipline and, frankly, the idea was ahead of its time - so it disappeared. Wicat was a very innovative company, sometimes too innovative for its own good!” This experience parallels that of the use of PDAs for Assessment of Workplace Competence in Hostile Environments (see Johnston, Rushby and MacLean, 2000) and the case study in the appendix.

We found that the practitioners and researchers we talked to were divided as to the value of the research carried out between 1980 and 2000 – and in consequence were divided as to the value of this project. Some were really not interested in the work carried out prior to 2000, could not see its relevance given that the technology has moved on and believe that the future is clearly Web 2.0. Others, once they were introduced to some of the projects, agreed that there was valuable information there. And some clearly saw the benefits and value to current practice.

The two issues here are awareness and availability. Through this project and the special issue of *The British Journal of Educational Technology* we have been able to introduce some members of the ICT community to some of the lessons of the past and we have been able to make a small amount of the documentation more accessible by digitising it.

In the longer term, there needs to be a national archive which can accommodate the documents and other artefacts and which has security for the future. That will require that it is supported with long term funding and by a library that is prepared to commit space into

the future. The past 25 years have seen the demise of the CEDAR collection at Imperial College and the fragmentation of the materials and documents from the Department of Education and Employment at Moorfoot. The artefacts from the National Interactive Video Centre (NIVC) and the Microelectronic Programme (MEP) have a precarious existence in a storage unit in Essex (see <http://www.naec.org.uk/>), but no permanent home. The Domesday material has only recently been rescued from obsolescent oblivion by the CAMiLEON project (Wheatley, 2004) and, unless it can find a home it may again be overtaken by technology to the point where it needs rescuing again.

Unless there is a commitment, perhaps by an appropriate agency or a charitable foundation, to establish a proper national archive, this material and the knowledge which is to be found within it will be lost forever. That would be an expensive tragedy.

3.1 Identified materials

The projects, articles and other documents from 1980s and 1990s yielded far more than we anticipated. As much as possible has been recorded in ways that more people can access. The range of topics is comprehensive, from specific subjects or skills through technology applications to the learning achieved using technology and where it was helped or hindered. An example of the range is shown in Table 3, from DfEE projects.

3.2 The short list

From this mass of material we then applied the criteria of the match to the research agenda and our views (together with those of the Sage Group members) to select the projects that we felt most relevant to those embarking on research projects today. The short list is shown in Table 2 and descriptions of each are given in the Appendix. Their links to the Becta Research agenda and the balanced scorecard are shown in Table 4.

- | |
|---|
| <ol style="list-style-type: none">1. Potential for Computer Assisted Assessment in the Assessment of National Vocational Qualifications2. Assessment of Competence in Hostile Environments3. Europe in the Round4. The Reading Disc5. Siville6. The Domesday Project7. Hypertext and learning styles: Optimising the effectiveness of training software8. ICCARUS9. Learning styles and technology based learning10. The Learning Credit Card11. Artificial Intelligence Applications to Learning12. Logic as a Computer Language for Children13. Who do you think you're talking to? and The Next Candidate14. Project Author |
|---|

Table 2: Short list of projects

Ref no	Title
OL144	Commercial viability of Tyneside TECs learning resource centre
OL147	Use of information technology in modern language learning
OL148	Using Hypertext to match learning styles with teaching and learning resources
OL149	Computer software to enable the study of mathematics
OL153	Travelling Open Learning service provided by the Highland Region library service
OL157	Open Learning provided by Glossop public library
OL158	Establishing an Open Learning centre in London
OL160	A guide for providers of Open Learning for people with disabilities
OL162	Using Open Learning with disadvantaged groups of learners
OL166	Descriptions of Technology Based Training methods
OL167	Preparing a Business Plan for a Learning Resource centre
OL168	Advantages of Open Learning for the self employed and SMEs
OL170	17 Open Learning projects undertaken by TECs and LECs
OL171	Training hairdressers using Open Learning at Glemby Ltd
OL172	Electronic simulators for training in the TV Programme Production industry
OL173	Description of the European Business and Languages Network
OL174	Assisting British Sign Language learning
OL175	Using Open Learning to train nursery assistants at Kids Unlimited
OL176	Adult dyslexia screening feasibility study
OL177	Using computers to translate industrial German
OL178	Delivering training to SMEs via a dial-up telephone service
OL179	Investigation of the relationship between flexible learning and small businesses
OL190	Authoring tools used to develop learning modules to meet literacy needs
OL191	Computer based learning about distributed computer systems
OL193	Open Learning French language training for the hospitality and leisure industry
OL194	Development and implementation of computer conferencing for an M.Sc. course
OL195	Four projects to provide Open Learning for people living on housing estates
OL196	Admin, Business and Clerical open learning for students with physical disabilities
OL197	Providing a tourist information system using multimedia
OL198	Creating an exhibition stand on a computer screen using virtual reality
OL199	Electronics training using telephone, audio-conferencing and tele-writing
OL200	Guidelines for producing Open Learning to match NVQs
OL201	Guide for designing learning systems
OL204	Development of low cost simulation for emergency response and pursuit driving
OL205	Interactive language learning using CD-ROM
OL206	Use of interactive audio and speech recognition techniques in training
OL208	Electronic performance support systems in a business environment
OL210	Description of 41 learning technology projects
OL211	Use of desk-top computer simulation in training
OL212	Using hypertext for the postgraduate certificate in technical authorship
OL214	Briefing notes for Open Learning project managers
OL216	Guide to using CD-ROMs for learning in the classroom
OL217	Feasibility of developing virtual reality packages for use in the classroom
OL219	Development of a cervical cytology multimedia learning programme
OL220	A guide to help the user get the best from Open Learning
OL222	Establishing a technology based learning advisory service
OL223	Cost effectiveness of Open and Flexible Learning
OL225	Computer based learning and assessment for the Security industry S/NVQs
OL226	Computers used for the assessment of prior learning in the catering industry
OL248	Guide to cost effectiveness of technology based training

Table 3: Fifty of the many projects carried out by the Department for Education and Employment on Open and Flexible Learning and Technology Based Training



1. Capability and capacity of the workforce, providers and learners	Research questions	Key projects
1.1 Leaders have the knowledge and skills to ensure technology for learning can be harnessed for the benefit of learners 1.2 Institutions and providers plan and manage technology for learning effectively and sustainably	<ul style="list-style-type: none"> • What works and what doesn't work in enhancing ICT capability? What can we learn from the failures of others? • How can practitioners keep abreast of rapid developments in ICT? 	<ul style="list-style-type: none"> • Project Author • Artificial Intelligence applications to Learning • The Domesday project
1.3 Practitioners exploit technology consistently to offer engaging and effective learning experiences	<ul style="list-style-type: none"> • How can technology be used to offer engaging and effective learning experiences? • How can communities of practice be encouraged? 	<ul style="list-style-type: none"> • Project Author • The Next Candidate • ICCARUS • Siville • The Domesday project
1.4 Practitioners, parent and learners can share and use information and data effectively for the benefit of learner	<ul style="list-style-type: none"> • How can we help parents to use information and data more effectively? • How can parents be motivated to do this? 	
1.5 Improved learner capability in using technology to support their learning	<ul style="list-style-type: none"> • What new skills are needed to learn through technology • What happened when earlier 'new' technologies were introduced into learning? • How can we help learners to use information and data more effectively and to develop the skills for learning through technology? 	<ul style="list-style-type: none"> • Logic as a Computer Language for Children • Artificial Intelligence applications to Learning • Learning styles and technology based learning
1.6 There is a greater choice in learning opportunities and modes for all learners	<ul style="list-style-type: none"> • How can technology be used to offer engaging and effective learning experiences? 	<ul style="list-style-type: none"> • Europe in The Round • ICCARUS • Learning styles and technology based learning

2. Fit for purpose technology and systems	Research questions	
2.1 All learners and practitioners have access to the appropriate technology and digital resources they need for learning	<ul style="list-style-type: none"> • What are the needs of the education system? What experience is there from other countries? • How can the ICT market be aligned with Becta's desired outcomes? • How can high tech markets be influenced to bring about the desired outcomes? 	<ul style="list-style-type: none"> • The Reading Disc • Europe in the Round
2.2 Every learner has a personalised learning space to enable them to learn when and where they choose		
2.3 Technology-enabled learning environments are secure, supported and interoperable	<ul style="list-style-type: none"> • What are the evolving needs of such an environment – now and in the future? • What functionality has been proposed and tested? What were the results? What has worked and what didn't work? 	
2.4 There is a dynamic, vibrant and responsive technology market that can meet the needs of the system	See 2.1 and 2.2	

3. Outcomes and benefits for learners and children	Research questions	
3.1 There is a greater choice in learning opportunities and modes for all learners	<ul style="list-style-type: none"> • How can technology be used to offer engaging and effective learning experiences? 	<ul style="list-style-type: none"> • Europe in the Round • ICCARUS • The Next Candidate
3.2 Learners have increased motivation for engagement in learning	<ul style="list-style-type: none"> • How can learners with different traits (personality, preferred learning styles etc) be motivated? • What strategies and tactics have been proposed and tested? What were the results? • How can these results be communicated to practitioners and the developers of learning materials so that they are acted upon? 	<ul style="list-style-type: none"> • Learning styles and technology based learning • Hypertext and learning styles
3.3 Fewer learners underperform or fail to succeed in education	<ul style="list-style-type: none"> • What are the causes of learner underperformance? • Does ICT introduce new causes of underperformance? • Are national tests valid indicators of learner performance in an ICT-rich environment? 	<ul style="list-style-type: none"> • Logic as a computer language for children
3.4 An improvement in the quality of learning provision is accelerated	<ul style="list-style-type: none"> • What do we mean (and what do others mean) by 'quality' in the context of learning provision? • Has learning provision improved in quality in other countries through the deployment of ICT? What were the factors involved? 	
3.5 There is improved child safety and child protection	<ul style="list-style-type: none"> • What factors influence child protection and well-being? • What experience is there of using ICT to influence child protection and well-being? • What experience is there from other countries? 	

4. Efficiency, effectiveness and value for money across the system	Research questions	
4.6 Learning providers collaborate and share information and resources	<ul style="list-style-type: none"> • What are the needs of the education system? What experience is there from other countries? • How can the ICT market be aligned with Becta's desired outcomes? • How can high tech markets be influenced to bring about the desired outcomes? 	
4.7 The management and administration of learning and institutions is more efficient	<ul style="list-style-type: none"> • What experiences are there of using ICT to support management and administration of learning and institutions in the UK and other countries? • What works and what does not? • What models are there for the successful deployment of ICT to support management and administration of learning and institutions in the UK and other countries? 	<ul style="list-style-type: none"> • Potential for computer assisted assessment • Assessment of competence in hostile environments
4.8 There is a greater level of effective, learner focused assessment for learning	<ul style="list-style-type: none"> • What experiences are there of using ICT to support learner-focussed assessment in the UK and other countries? • What works and what does not? • What models are there for the successful deployment of ICT to support learner-focussed assessment in the UK and other countries? 	<ul style="list-style-type: none"> • The Learning Credit Card • Assessment of Competence in Hostile Environments
4.9 Practitioners collaborate and share good practice and learning resources	<ul style="list-style-type: none"> • How can communities of practice be encouraged? • What are the changing ways in which practitioners seek credible evidence of best practice? 	
4.10 There is good use of information to support learner transition between institutions and sectors	<ul style="list-style-type: none"> • What information is needed by the learner, the institutions and other stakeholders in the transitions between educational sectors (and beyond into workplace training)? • How can technology support the collection, processing and presentation of that information? • What functionality and technologies have been proposed and tested? What were the results? 	<ul style="list-style-type: none"> • The Learning Credit Card

Table 4: Types of evidence required to support the Balanced Scorecard

3.3 Carrying out a literature search

A drunk was stumbling about searching the ground beneath a street lamp. A passer-by asked what he was doing. "I'm looking for a coin that I dropped over there," he said. "But if you dropped it over there then why are looking somewhere else?" he was asked. "Because the light's better over here," he replied.

Perhaps part of the problem lies in the way in which students are trained to carry out literature searches, combined with the pressures on space which is resulting in libraries reducing their print holdings. If it cannot be found on the Web (which is not quite the same as not existing on the Web) and is not physically on the shelves then the assumption is that it does not exist. After they graduate these researchers seemingly continue to operate in the same way.

In preparing for this project, we spoke to a number of researchers who reported that the way they had been taught to carry out a literature search had focused almost entirely on the use of online search engines and the associated tools of citation searches. To support the detailed research and acquisition of resources in this project, we compiled a database of the tables of contents of a number of key journals. We experienced considerable frustration in locating physical holdings of some journals because they were no longer available in libraries in the South East of the UK. They might well be available further afield, perhaps in other university libraries or at the British Library in Boston Spa, but the opportunity cost of accessing a physical paper that has to be ordered from another library is likely to deter all but the most enthusiastic. Even where a journal was available online we found that it might not be accessible to researchers. Libraries differ in their online subscriptions. Thus for example, we found that one university could access issues of *Computers and Education* back to 1995 while another could only access back to 1998. The paper we wanted was from 1992 and was eventually tracked down to a physical issue in their library. The point here is that although the paper may be available if (a) the researcher knows what they are looking for and (b) is persistent in the search and (c) is prepared to pay for a copy or (d) is prepared to spend time on the phone locating a library that may have a copy and then (e) go there to read and/or make a photocopy, the opportunity cost of tracking it down is high. It is much easier to focus on material that is readily available and where the citations may lead to other material that can fill up the literature search. Web-based searches give us the opportunity of substituting breadth for depth in our literature searches.

The project team had a major advantage in searching for key projects during the period 1980-2000 in that they had been working in the field at the time and had input from the Sage Group who were also intimately involved in many of those projects. Of course, online searches played an important role, but it helped to know where to look! To a certain extent the search concentrated on the places 'where the light was best' – in other words in journals that were considered to be particularly relevant and for papers and reports by people who were known to be working in specific areas and on specific projects..

Keyword searches and citation searches yielded part of the picture: another important part came from personal networks and from the private collections of papers and reports that had been stored in attics and garages – and in some cases on bookshelves in studies at home. The literature search then became a process of

gathering and assembling forensic evidence from a number of sources.

An important factor is the belief held by some researchers that ICT is such a new technology that there can be nothing important prior to about 2000. If there is nothing to be found then clearly there is little point in searching for it. Keeping in mind the quote by George Santayana at the beginning of this paper, there is a strong case for including the history of learning technology and ICT in the development programme for researchers and practitioners. This should of course, go back beyond 1980: there are valuable lessons to be learned from the programmed learning movement and the researchers on the previous two decades!

We conclude from our experience that, although the web can make an important contribution, an effective literature search needs to draw on a variety of sources including personal contacts. Peer networking is one of the most valuable resources for pulling on the ends in the tangled ball of string that makes up the interwoven literature of e-learning.

4. Conclusion

This has been an interesting project and we believe it has revealed results that are useful to the research community and practitioners. We have made some of the documents available in full and others project have references that can be followed up. The 1980s and 90s were a time when exploratory projects were undertaken with a clear link between three aspects: of learning the content, the 'people' factors and the technology. Some of the findings had been used in subsequent projects while other findings from those same projects have been forgotten as they did not relate directly to the situation at that time. Yet, with changing circumstances, they could be used now to inform other research and development – now and in the future.

The problem is to secure this information for the future. One disconcerting discovery while carrying out our investigations was the number of times collections of materials had to be moved because space was required for other things. This has happened not once but several times. Even now there are materials looking for a home which will be destroyed and lost forever if someone does not step in to save them. A long term solution is needed..

5. Acknowledgements

This project was funded by the British Educational Communications and Technology Agency and our thanks go to the staff of the Evidence and Evaluation Directorate for their support, initially of the concept, and subsequently in realising the outcomes. We would not have been able to provide a balanced and comprehensive coverage of the key projects of the period without the help of the members of the 'Sage Group': Mike Bower, Colin Buckley, Liz Burge, Judith Christian-Carter, Donald Clark, Alan Clarke, Christopher Dean, Donald Ely, Richard Ennals, David Hawkrige, Diana Laurillard, Keith May, Keith Shaw, John Twining, Quentin Whitlock, and Jim Wilson.

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Appendix A The key projects

<i>Project title</i>	1. Potential for Computer Assisted Assessment
<i>Principle researcher</i>	Christine Ward
<i>Contact details</i>	Guildford Educational Services Contact Christine Ward Ward Educational Consulting 21 Church Hill Aldershot Hampshire GU12 4JT Tel: 01252 336298
<i>Dates</i>	1991
<i>Description</i>	<p>This project provided the foundation for many future developments in Computer Assisted Assessment in vocational education.</p> <p>The overall background to the project had two aspects, one of which was the developing framework of National Vocational Qualifications based on industrially defined standards of competence. Within the NVQ system, emphasis is placed mainly on the practical demonstration of competence in the workplace, but there was a growing realization that workplace observation needed to be supplemented by other assessment methods. Reasons put forward for this included:</p> <ul style="list-style-type: none"> • Concerns about the quality of assessment, in terms of both coverage and consistency • The difficulty of covering the whole range of situations in which candidates are expected to be competent by means of workplace observation. • The need to assess underpinning knowledge and understanding which cannot necessarily be inferred from workplace performance. • Pressures for increased rigour in the assessment process • The heavy burden placed on assessors, both in assessment and in recording. • The cost of assessment. • Difficulties of access for candidates not in employment or employed in an occupation with a restricted range of opportunities to demonstrate competence. <p>Other problems were believed to be occurring because of difficulty in interpreting the requirements of the standards for individual competence elements or for combinations of evidence and because of difficulties in coordinating the standards of assessors.</p> <p>One part of the project was to conduct a survey of centres and lead bodies to discover how far their experience confirmed that such difficulties were being encountered in practice.</p> <p>The second major aspect to the overall background was the developments made in information technology during the 1980s.</p>

Such developments had been harnessed to provide imaginative computer based training packages, as well as interactive video and other more advanced applications, and it was thought that similar techniques might be used to solve some of the problems of assessment.

The report (Ward 1991) identifies further development which was needed to make computer assisted assessment techniques fully operational. Outline specifications were prepared for projects which the Employment Department might undertake to promote the development and implementation of computer assisted assessment.

(from the final project report, Ward, 1991)

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Ward, C (1991) *The potential for Computer Assisted Assessment in the Assessment of National Vocational Qualifications*, Report for the Employment Department (TEED), Guildford, Guildford Educational Services. (digitized as part of this Becta project)

<i>Project title</i>	2. Assessment of Competence in Hostile Environments
<i>Principle researchers</i>	Nick Rushby, PA Consulting Group Bob Fairbrother, British Rail
<i>Contact details</i>	Nick Rushby, Conation Technologies Limited, The Office Building, Gatwick Road, Crawley, West Sussex RH10 9RZ UK
<i>Dates</i>	December 1993-December 1995
<i>Description</i>	<p>This was a study of the use of personal digital assistants (PDAs) as job aids for the assessment of competence, particularly in difficult and hostile environments. The pilot application was trialled successfully within British Rail and the concept was applied in several other industries (eg, airline crew resource management). It pioneered the use of hand-held devices to support supervisor/assessors in the assessment of competence in the workplace.</p> <p>British Rail was chosen as a specific example of an organisation needing to carry out workplace assessment in a hostile environment. The study built upon the Training Development and Delivery Programme which re-engineered the training system for signal and telecommunications staff in British Rail. The issue of workplace assessment and the resources needed to implement it sensibly were a continuing cause of concern to the Programme and the study was driven by that need. The 'ideal' process and the specification for a data collection system were derived from discussions with staff at all levels: technicians, supervisors, those training supervisors in assessment techniques, managers and engineers.</p> <p>The Project examined a number of possible PDA devices to determine how well they met the functional requirements and technical specification. The Apple Newton MessagePad was selected as the most appropriate device for the demonstration system which was then evaluated in the workplace of West Anglia Infrastructure Support Unit.</p> <p>A workplace study was devised to evaluate the concept of PDAs as job aids for workplace assessment in the signal and telecommunications environment of British Rail. The study concluded that PDAs are effective job aids for workplace assessment in this environment and that, given the need to be certain that staff are competent to undertake safety critical work, the cost-benefit of the approach can be demonstrated. Where there is less emphasis on safety critical work, then the case is less clear, unless workplace assessment in one of a portfolio of performance support applications provided through a PDA.</p>
<i>References</i>	<p>Rushby N J and Fairbrother R (1995) <i>Workplace assessment in a hostile environment</i> Report OL232, Department for Education and Employment. Sheffield.</p> <p>Rushby N J (1996) Assistants for assessment <i>Innovations in Education and Training International</i> 33, 3, pp154-161.</p>

<i>Project title</i>	3. Europe in the Round
<i>Principle researcher</i>	Jacquetta Megarry
<i>Contact details</i>	Landrick Lodge, by Dunblane Scotland FK15 0HY
<i>Dates</i>	1989-1993
<i>Description</i>	<p>At the AETT Conference at Plymouth in 1988, Jacquetta Megarry in a keynote address postulated that the combination of Hypertext and CD-ROM (then both very new) would provide a powerful learning tool. The Employment Department funded this project to test this thesis. Such combination is now commonplace.</p> <p>Europe in the Round was an information resource for anyone interested in European education and training or in working in Europe. As a self-contained reference library it was designed for easy operation by users ranging from primary school children to adults.</p> <p>The Employment Department funded the development of the resource specifically to support students studying SCOTVEC modules leading to a qualification in European Studies. Initially written in Hypercard, the system was also implemented in Toolbook and the Employment Department also funded the development of a full colour version.</p> <p>A total of 75 users participated in two rounds of structured field testing completing a two page feedback form and supplying extensive comments. The project reports provide excellent guidelines for the human computer interface design.</p> <p>The software was greeted with great enthusiasm among users ranging fro 6 to 86 years of age, most with little of no computer experience. It was therefore launched in 1991 as a commercial product for the Apple Macintosh and later that year for IBM PCs.</p>
<i>References</i>	<p>Megarry, J. (1988) Hypertext and compact discs: the challenge of multi-media learning <i>British Journal of Educational Technology</i> 19, 3. pp 172–183.</p> <p>Megarry, J. (1991) Hypertext and compact disc revisited: Europe in the Round <i>British Journal of Educational Technology</i> 22, 3. pp 224–227.</p> <p>Megarry, J. (1991) 'Europe in the Round': Principles and Practice of Screen Design <i>Programmed Learning and Educational Technology</i> 28, 4. pp 306-315.</p>

<i>Project title</i>	4. The Reading Disc
<i>Principle researcher</i>	Martin Good
<i>Contact details</i>	Tribal CTAD Lincoln House, The Paddocks 347 Cherry Hinton Road Cambridge CB1 8DH
<i>Dates</i>	1993
<i>Description</i>	<p>A significant development project which focused on a critical government priority (literacy). It illustrates many factors including how a research and development project can lead to a commercial product. Indeed, the <i>New Reading Disc</i> continues to be published by CTAD (Tribal). The entry on the Tribal website describes it as an "engaging resource [which] uses sound, pictures, video and text. Learners can write articles and letters, debate, practice map reading and play word games. They learn to read by writing, improving their skills and confidence. The <i>New Reading Disc</i> is suitable for learners of all ages from 14+ looking to improve their spelling skills.</p> <p>The software package is based on the Language Experience Approach which encourages the individual to define the content of his or her practice materials. Research had shown that progress is maximized when the learner is able to read or write about his or her own interests, and the interest factor is key to overcoming motivational problems. Before developing the Reading Disc, CTAD canvassed the view of some 300 literacy students at reading centres across the UK. Feedback was analysed, providing the company with a body of information about preferred topics and materials.</p>
<i>References</i>	--- (1993) <i>Basic Literacy Via CDROM XA: The reading disc</i> , Summary report T89 23H 181 Employment Department, Learning Methods Branch, Sheffield. (digitized as part of this project)

<i>Project title</i>	5. Siville – a language training simulator
<i>Principle researchers</i>	Donald Clark
<i>Contact details</i>	EPIC Group plc, 52 Old Steine Brighton BN1 1NH Tel: 01273 728686
<i>Dates</i>	c1992
<i>Description</i>	<p>This French language teaching programme, designed and built by Epic for secondary schools, simulates the experience of arriving in a small French town (in reality, Dieppe). Tests with children showed that optimum success was reached with small groups of three children who encouraged each other to learn and were uninhibited in the sense that they would willingly talk to the screen in French. The anonymity of the machine was an asset and the absence of any adult teachers was essential.</p> <p>The learners start by selecting whether they were male or female. This triggers the characters on the programme to talk to you in either male or female voices, as it was felt important to represent children in a voice of their own sex.</p> <p>They are then given some money, and their objective is to move around the town of Siville, visiting shops and buying everyday items. To purchase the items, they have to use everyday French vocabulary and numbers. If they get lost, a Gendarme is on hand to give directions.</p> <p>The programme was designed to teach French to secondary school children, using a structured, problem-solving approach to language learning. Epic worked with HM Schools Inspectors and teachers to develop the teaching materials, then produced the video, audio and interactive components. The programme takes place in an imaginary French town, which was created using 3D film graphics. They may roam the town, going up and down the streets in any direction; turning in the direction of your choice at junctions and choosing to enter any shops you pass along the way. There are set tasks of increasing difficulty, of buying one or more items from one or more shops.</p>
<i>References</i>	(from Clark, 2003) Clark, D. (2003) <i>Simulations and e-learning</i> White paper. Brighton, EPIC Group plc. Plowman, L. (1994) The 'primitive mode of representation' and the evolution of interactive multimedia <i>Journal of Educational Multimedia and Hypermedia</i> 3, 3/4. pp 275-293. Retrieved on 5 th December 2007 from http://kn.open.ac.uk/public/getfile.cfm?documentfileid=816 .

<i>Project title</i>	6. The Domesday Project
<i>Principle researchers</i>	Peter Armstrong, BBC Television
<i>Contact details</i>	Not available.
<i>Dates</i>	1986
<i>Description</i>	<p>The Domesday Project had its origins in 1983 when, with the 900th anniversary of the original Domesday Book approaching, Peter Armstrong of the BBC conceived the idea of a 20th Century version that would catalogue life in the UK but would use multimedia instead of paper. The resulting digital resource was compiled with input from hundreds of thousands of schoolchildren, a team of 60 researchers from the BBC and a vast number of other scholars, statisticians and photographers from the across the UK.</p> <p>The Twentieth Century Domesday ‘book’ comprised two Laservision discs were used with a modified BBC microcomputer and was designed to be used by novice users. Unfortunately, by the time it was published, the price had risen to around £400 and it was perceived as overpriced. But, twenty years on “ BBC Domesday is viewed in a very different light. It is seen as [a] masterpiece of design and organisation, and a landmark in the development of multimedia that failed only because it was way ahead of its time.” (Wheatley, 2004).</p> <p>The videodiscs were enhanced by Barbour (1990) so that they can provide a learning environment that is matched with learning style and they have been the subject of a recovery programme by the CAMiLEON project (Wheatley, 2004) so that this important resource is not lost as a resulting of changing digital media.</p>
<i>References</i>	<p>Armstrong P and Tibbetts, M (1986) <i>Domesday videodisc user guide</i>, London, BBC Publications.</p> <p>Barbour, R. (1990) Enhancing the BBC Domesday videodisc as a learning environment for New Zealand secondary schools <i>British Journal of Educational Technology</i> 21, 2. pp 142-143.</p> <p>Wheatley, P. (2004) Digital Preservation and BBC Domesday. Paper presented at the Electronic Media Group Annual Meeting of the American Institute for Conservation of Historic and Artistic Works. Portland, Oregon. June 14, 2004. Retrieved on 5th December 2007 from http://aic.stanford.edu/sg/emg/library/pdf/wheatley/Wheatley-EMG2004.pdf</p>

<i>Project title</i>	7. Hypertext and learning styles
<i>Principle researchers</i>	David Ellis, Nigel Ford, Frances Wood, Dave Clark and Geoff Smith
<i>Contact details</i>	Sheffield University Department of Information Studies Western Bank, Sheffield, S 10 2TN
<i>Dates</i>	1992-1995
<i>Description</i>	<p>Training can be an expensive commodity. Reducing the time needed for training and increasing its effectiveness and durability are thus important aspects in the development of software destined for Open Learning applications. The advent of the Single European Market in 1992 led to fundamental changes in the law and practices relating to commercial and industrial operations. Both managers and staff had to learn quickly in order to assimilate these changes. There is evidence that training can be more effective when it is matched to learners' individual styles and strategies for processing information. Many traditional teaching methods do not effectively match the presentation of information with specific learning needs.</p> <p>Because of the lack of enabling technology, it has not previously been practical to implement the matching of cognitive and behavioural aspects of learning styles with teaching approaches and learning resource development. However, matching teaching with learning styles and strategies has become much easier with the advent of an enabling technology known as HYPERTEXT.</p> <p>Hypertext was designed to be utilised in the production of learning packages which would reduce training time and increase the durability and quality of training. The ultimate aim of hypertext was to make technology-based training more cost-effective. Hypertext has exciting potential for developing training approaches and materials likely to achieve significant improvements in the quality of training. This project sought to exploit the contribution which this technology could make to developing training packages geared closely to trainees' own individual styles and strategies.</p>
<i>References</i>	<p>(from the project summary, Ellis <i>et al</i>, 1995) Ellis, D, Ford, N, Wood, F, Clarke, D Smith G, and Alan Griffiths. (1995) <i>Hypertext and learning styles: Optimising the effectiveness of training software</i>, Report OL148 for the Department for Education and Employment. Sheffield University Department of Information Studies. (available from Keith May Consulting)</p>

<i>Project title</i>	8. ICCARUS
<i>Principle researchers</i>	James Powell, Paul Newland, Chris Creed, Theo Wright and Brian Logan
<i>Contact details</i>	Paul Newland University of Portsmouth, Centre for New Media Research Lion Gate Building Lion Terrace Portsmouth, Hampshire PO1 3HF +44 (0)1705 842297 paul.newland@port.ac.uk
<i>Dates</i>	1988-1992
<i>Description</i>	<p>This was part of a small group of projects aimed at police and fire fighters using simulation but also considering learning styles. The cost of a major fire in terms of property and content damage averaged (in 1993) £10,000 per minute. A saving of only one minute on every major fire in the UK would give a financial saving of £80 million each year.</p> <p>The project team believed that it was possible to educate a fire officer to deal intelligently with the command and control of a major fire event he will never have experienced. It involved the development of an intelligent simulation based upon computer managed interactive media. The expertise and content underpinning this educational development was provided by the West Midlands Fire Service. Their brief for this training programme was unambiguous and to the point:-</p> <ol style="list-style-type: none">1. Do not present the trainee with a model answer, because there are no generic fires. Each incident is novel, complex, and often `wicked' in that it changes obstructively as it progresses. Thus firefighting demands that Commanders impose their individual intelligence on each problem to solve it.2. A suitable Educational Simulator should stand alone; operate in real time; emulate as nearly as possible the `feel' of the fireground; present realistic fire progress; incorporate the vast majority of those resources normally present at a real incident; bombard the trainee with information from those sources; provide as few system-prompts as possible.3. There should also be an interrogable visual debrief which can be used after the exercise to give the trainees a firm understanding of the effects of their actions. This allows them to draw their own conclusions of their command effectiveness. Additionally, such a record of command and control will be an ideal initiator of tutorial discussion.4. The simulation should be realisable on a hardware/software platform of £10,000.5. The overriding importance is that the simulation should "emulate as nearly as possible the feelings and stresses of the command role". <p>Iccarus (Intelligent Command and Control: Acquisition and Review Using Simulation) uses techniques drawn from artificial intelligence. The interactive simulation allows for senior fire officers to practice the</p>

command and control of large fire incidents as a restricted but genuine experience of real time crisis decision making. Through a sophisticated iconic interface the commander / learner can formulate decisions, send messages, deploy men, ask for appliances, talk to persons involved and then experience the consequences of his / her actions. A record of the commander / learner's actions is created in parallel with the development of the fire and the events in the simulation to allow a debrief to be analysed at the end of the simulation. The simulation will never run the same way twice thus a learner can repeat the experience with benefit.

- References* J. Powell, T. Wright, P. Newland, C. Creed and B. Logan (1992) Fire Play: ICCARUS - Intelligent Command and Control, Acquisition and Review Using Simulation, *Interactive Learning International* **8**, 2. pp 109-126. Retrieved on 5th December 2007 from <http://www.envf.port.ac.uk/newmedia/papers/IC/ICCARUSpaper.htm>.

<i>Project title</i>	9. Learning styles and technology based learning
<i>Principle researchers</i>	Richard Riding, Eugene Sadler-Smith (among others)
<i>Contact details</i>	Richard Riding, Formerly Director of Assessment Research Unit Faculty of Education and Continuing Studies University of Birmingham Eugene Sadler-Smith, Department of Business, Economics and Management, University of Plymouth Business School, Plymouth PL4 8AA Tel: 01752 232870; email: eugene.sadler-smith@pbs.plym.ac.uk
<i>Dates</i>	Various
<i>Description</i>	<p>Although the usefulness of learning styles is hotly debated and recent research has thrown doubt on the predictive validity and reliability of many of the instruments that have been developed over the past years (Coffield, Moseley, Hall and Ecclestone, 2004), the research carried out in the 1990s by Riding, Sadler-Smith and others had a significant influence on a number of technology based learning projects. For example, the ICCARUS project used an introductory test to determine the user's preferred learning style and subsequently adapted the presentation of the learning to take that preference into account.</p> <p>The possibility of different preferred learning styles in the learner population caused problems for the instructional designer and the developer of the learning programme. It suggested that there should be a number of alternative routes through the material, adding to the complexity of the programme and, more importantly, adding to the cost. Some work was carried out with intelligent tutoring systems to incorporate the preferred learning style in the learner model but without conspicuous success.</p> <p>The issue is of greater interest to the training community than to those in education because the latter have recently moved to a constructivist approach in which the learning styles implicit within the materials have less effect. However, where a specific body of facts have to be communicated and learned (as in training) learning styles still have an important role.</p>
<i>References</i>	<p>Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). <i>Learning styles and pedagogy in post-16 learning: A systematic and critical review</i>, Learning and Skills Research Centre</p> <p>Riding R (1996) <i>Learning Styles and Technology Based Training</i> Department for Education and Employment (Learning Methods Branch report), Sheffield.</p> <p>Riding R J and Eugene Sadler-Smith E (1997) Cognitive Style and Learning Strategies: Some Implications for Training Design <i>International Journal of Training and Development</i> 1 (3), 199–208.</p> <p>Sadler-Smith E (1996) 'Learning Styles' and Instructional Design <i>Innovations in Education and Teaching International</i> 33, 4 pp 185-193</p>

<i>Project title</i>	10. The Learning Credit Card
<i>Principle researchers</i>	Nick Rushby, PA Consulting Group John Twining, Guildford Educational Services
<i>Contact details</i>	Nick Rushby, Conation Technologies Limited, The Office Building, Gatwick Road, Crawley, West Sussex RH10 9RZ UK
<i>Dates</i>	January 1990-December 1992
<i>Description</i>	<p>A feasibility study of using technology to provide a continuous guidance and counselling service to individuals at the workplace, which will support them in meeting their personal development aims and objectives. It was one of the earliest projects (probably the earliest in the UK) to investigate the use of e-portfolios and smart cards. It also incorporated a planning tools based on hypertext-based representation of competences.</p> <p>In the 1990s the predominant use of smart cards was in financial services. Even the limited cards of that time had the potential to store details of a user's learning needs, competences and previous experience. The project, funded by the Employment Department reported on many aspects of smart cards including current and potential use in learning and built two working systems as proofs of concept.</p> <p>In education and training the level of interest was high but understanding of the technology was low. Possible applications suggested to the project team included assessment, course planning and management, e-portfolios, identification of learning opportunities and ownership of learning.</p>
<i>References</i>	<p>Rushby, N J (2002) <i>The Learning Credit Card: a tool for managing personal development</i>. White paper. Crawley, Conation Technologies</p> <p>Rushby N J, Twining J, Twining N and Devitt T (1990) The learning credit card <i>Interactive Learning International</i> 6, 3. pp119-142. (reprinted as part of this project)</p> <p>Rushby N J, Twining J, Twining N and Devitt T (1990) Smartcard: the learning credit card. Employment Department, Learning Technologies Unit, Sheffield.</p>

<i>Project title</i>	11. Artificial intelligence applications to learning
<i>Dates</i>	1987-1990
<i>Description</i>	<p>There was a belief in the 1980s that artificial intelligence (AI) must have a part to play in the development of computer based learning. This belief was born not only of the enthusiasm with which technology was being embraced, but was also based upon the success of recent initiatives, mainly academic, that suggested that AI represented a serious new approach that would have a bright future in industrial and commercial learning.</p> <p>In addition to the funding for AI research through European programmes such as DELTA (Developing European Learning through Technological Advance) and RACE (Research and Development in Advance Communications Technologies in Europe), the Department for Education and Employment set up a number of projects that explored the applications of AI in education and training. The overall budget for these projects was £3.2M. Although it was not intended as a coordinated programme of projects, they were inevitably grouped together and known as the 'AI Applications to Learning Programme' and became the first concerted attempt to evaluate the place of AI in education and training in Europe.</p> <p>The projects covered a wide range of training requirements and applications, including:</p> <ul style="list-style-type: none"> • an expert system on customer complaints procedure for use by catering students and small businesses • computer based training and simulation linked with an expert system to train staff to operate and maintain a process plant • an expert system training package to help owner-mangers in business planning • training in statistical quality control • intelligent courseware for insurance underwriting • an intelligent interactive video simulation on the fire control of large incidents • an intelligent training and advice system for small business on employing people <p>The outcomes of these projects and the reasons why artificial intelligence did not live up to its initial promise are discussed by Welham (2008).</p>
<i>References</i>	<p>Goodman, L. (1989) Evaluation of the Further and Higher Education (FHE) Section of the Training Agency's 'AI Applications to Learning' Programme, <i>Programmed Learning and Educational Technology</i>. 26, 4. pp322 – 334.</p> <p>Welham, D. (2008) Artificial Intelligence in Training 1980 – 2000: Foundation for the future or misplaced optimism? <i>British Journal of Educational Technology</i> 39, 3.</p> <p>Williams, N. (1992) The Artificial Intelligence Applications to Learning Programme. <i>Computers Educ. Vol18 No 1-3, pp 101-107.</i></p>

<i>Project title</i>	12. Logic as a computer language for children
<i>Principle researchers</i>	Robert Kowalski Richard Ennals Jonathan Briggs
<i>Contact details</i>	Richard Ennals, Kingston Business School, Kingston Hill, Kingston-Upon-Thames, Surrey, KT2 7LB Tel: 020 8547 2000 x65242
<i>Dates</i>	1981-1982
<i>Description</i>	<p>LOGO was created at Bolt, Beranek and Newman in 1967 by a team that included Seymour Papert who went on to pioneer its use in schools to create a "mathland" where children could play with words and sentences. Modeled on LISP, the design goals of Logo included accessible power and informative error messages (Papert 1980). The use of virtual Turtles allowed for immediate visual feedback and debugging.</p> <p>The later development of PROLOG around 1972 was motivated in part by the desire to reconcile the use of logic as a declarative knowledge representation language with the procedural representation of knowledge that was popular in North America in the late 1960s and early 1970s. Unlike languages such as Fortran, Basic and Algol in which the programmer encodes an algorithmic solution to a problem, PROLOG works with a description of the problem and generates logical solutions.</p> <p>In 1980, a version of PROLOG called microPROLOG became available and the project "Logic as a Computer Language for Children", based at Imperial College started to explore its application in the classroom. The premise was microProlog contributes to promoting logical thinking for use throughout the school curriculum and that it can stand as a subject on its own. that Evaluations were conducted in a number of schools and colleges, and courses were held for teachers in various parts of England. Ennals (1983) remarked on the quickness that children could learn microProlog, building their own databases and formulate queries, so promoting clear thinking and expression.</p>
<i>References</i>	<p>Ennals, R (1983) <i>Beginning micro-Prolog</i>, Chichester, Ellis Horwood.</p> <p>Kowalski R (1984) <i>Logic as a computer language for children in</i></p> <p>Yazdani M (Ed) <i>New Horizons in Educational Computing</i> , Chichester, Ellis Horwood. Pp121-144.</p> <p>Papert, S. (1980) <i>Mindstorms: Children, computers and powerful ideas</i>, Brighton, Harvester.</p>

<i>Project title</i>	13. Who do you think you're talking to? The Next Candidate
<i>Principle researchers</i>	Nick Rushby, Centre for Staff Development in Higher Education, London Institute of Education
<i>Contact details</i>	Nick Rushby, Conation Technologies Limited, The Office Building, Gatwick Road, Crawley, West Sussex RH10 9RZ UK
<i>Dates</i>	1987 - 1989
<i>Description</i>	<p><i>Who do you think you're talking to?</i> was an interactive video-based training package for bus drivers to improve their inter-personal skills when dealing with difficult situations that might otherwise culminate in an assault on the driver. It was one of the first projects to use interactive video for interpersonal skills training. It was funded by the Local Government Training Board on behalf of London Buses.</p> <p><i>The Next Candidate</i> extended this work to develop a multimedia interpersonal skills training course in interviewing skills (clients include PA Consulting Group and a major insurance company). A series of simulated interviews was used to confront learners with the consequences of their preparation for the interview and their behaviour as interviewers. This training package comprising a highly interactive set of videodiscs was published commercially in Europe and North America and demonstrated (a) the possibility of simulating convincing dialogues using interactive video, (b) the use of voice input for a technology based training package, (c) the use of natural language processing.</p>
<i>References</i>	<p>Rushby, N J, Weil, S, Schofield, A, and Delf, G (1987) The ubiquitous trigger: a flexible resource. <i>In</i> Percival F (Ed) <i>Aspects of Educational Technology XX: Flexible Learning</i>. Kogan Page, London</p> <p>Rushby, N J (1987) From trigger video to videodisc: a case study in interpersonal skills. <i>In</i> Laurillard, D (Ed) <i>Perspectives in interactive video</i>. Ellis Horwood, Chichester.</p> <p>Rushby, N J and Schofield, A (1988) Conversations with a simulacrum. <i>Simulations, Games for Learning</i></p>

<i>Project title</i>	14. Project Author
<i>Principle researchers</i>	Mike Bower, Datasolve Education
<i>Contact details</i>	CBT Solutions 3 Gratwicke Cottages Henfield Road Cowfold West Sussex RH13 8HL
<i>Dates</i>	1983-1988
<i>Description</i>	<p>Not so much a research project as an initiative to address the skills shortage in the developing technology based learning industry, <i>Project Author</i> evolved from recognition by industry and commerce that classroom trainers did not currently have the competences required for the design of digital learning resources. It recognised that Technology Based Training was radically different from classroom training, which is reactive to its learners, and has a different skillset which emphasises anticipation of learners actions, apart from the additional requirements of using the technology.</p> <p>Project Author addressed that need by creating an intensive short course for those with an understanding of learning (usually trainers and teachers) with the added dimension that the trainees were currently unemployed. It was linked to a government initiative to retrain these people (as a Manpower Services Commission TOPS course). The early versions of the course included five weeks on secondment in industry and many organisations that provided placements frequently took on their student(s) full time after the course ended. Because it was industry based and funded from the Department of Employment the course was freed from outside constraints frequently applied to academic based courses. It played a pivotal role in creating the current UK e-learning industry and many of its graduates now occupy senior positions in the industry.</p> <p>Project Author serves as a model of how to deliver effective staff development.</p>
<i>References</i>	None available