# How compelling is the evidence for the effectiveness of e-Learning in the post-16 sector?

Benedict du Boulay, Julie Coultas and Rosemary Luckin

CSRP 595

January 2008

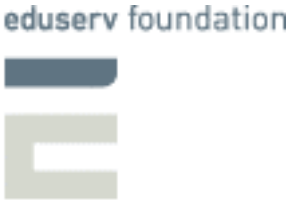
ISSN 1350-3162

University of Sussex

---

Cognitive Science
Research Papers

---


# How compelling is the evidence for the effectiveness of e-Learning in the post-16 sector?

## A review of the literature in higher education, the health sector and work-based learning and a post-review stakeholder consultation

**January 2008**

**Benedict du Boulay[1]**
**Julie Coultas[1]**
**Rosemary Luckin[2]**

***IDEAS Lab[1]***
***Human Centred Technology Group***
***School of Science and Technology***
***University of Sussex***

***London Knowledge Laboratory[2]***
***Institute of Education***

**http://www.reveel.sussex.ac.uk/**

# CONTENTS

**Executive Summary**

*The findings of the modified systematic review of the literature were presented to a Roundtable of international e-learning experts at the e-learn conference in the USA in 2006. This generated useful observations and additions to the outcomes of the review, which were then presented as an issues paper at a workshop with a group of senior academics and policy professionals in the UK. The purpose of this workshop was to review the findings and identify key research and policy issues that emerged from the work. In completing this work we have tried to pull together the findings into a form that will be useful to a range of academics and policy professionals working in a range of educational institutions.*

**Key findings of the Review**

E-learning is a dynamic that has been both complex and ever-changing, so to measure how effective it has been in itself is a challenge. The review identified definitional elements, key factors in e-learning, how to measure effectiveness within the literature, but also raised the question of whether the research was examining the right issues, which was born out in the review process. Relevance to institutions, work-based learning and health were also reviewed.

Definitions were identified as containing three components; skills, computer technology and style of learning. Key factors in e-learning were identified as being learner confidence, prior knowledge (both operational and conceptual), the presence and involvement of the Teacher, communication (the dialogues between teachers and learners) and the cultural issues relating to managing change. This range of categories in itself identifies the complexity of the field under review, even so both the complexity of the definitions, and the number of key factors, were added to through the expert review process.

**Key findings of the Roundtable**

E-learning requires a different mode of learning, which was characterised as "independent learning", and critically changes the combinations of Space, Time and Money necessary for learning to take place. Teachers are beginning to get insights in how to use "timely interventions" to deal with a learning mix of "theorising and socialising". Institutions, however, are not yet equipped to modify the ways that they deal with these combinations not least because key performance indicators (KPI's) map to traditional learning outcomes.

**Key findings of the workshop**

E-learning is no longer a subset of learning used in distance learning but has evolved into "learning in technology-rich environments" which occurs in multiple contexts both within and beyond the institution. With technology and learning both developing rapidly, but independently, we have the capability for the co-creation of learning through the integration of the range of technologies available for learning. Institutions however need to move away from the use of simple KPI outcome measures and begin to focus on quality improvement.

**Conclusion**

The review has identified many policy and research issues to act upon which develop from the key finding that we are at the end of e and are now learning in technology-rich environment. These are recommendations, which can be acted on by a range of institutions, agencies and government departments.

## *Specific recommendations for future research*

In each section of the review chapters we make recommendations for future research. We summarise them here.

In *higher education* we should look at

- Students' attitudes to different methods of assessment when using e-Learning
- The effect of faculty use of technology on the attitudes and behaviour of students (role modelling)
- The impact of the integration of learning activities with assessment in a networked learning environment
- When collaboration works and when it breaks down
- The impact of e-Learning strategies on the higher education institution

In *medical education* we should look at

- The experience of the off-campus or long distance learner
- The contextual nature of learning by including more than one level of evaluation of e-Learning e.g. gauging the reactions of the learners (self report) and also observing the behaviour
- Student, practitioner and faculty use of handheld devices in more depth
- The pattern of adoption of e-learning in the organisation through longitudinal studies

In *work-based e-Learning* we should look at

- The trainee's experience of e-learning in more depth
- Computer anxiety as this has been identified as a major barrier
- The interaction between literacy levels and success with e-Learning
- The use of different levels of flexibility of a system. For example the opportunity to ask questions or go beyond what is expected can influence employees
- Changes in the way that communication takes place as a result of new technologies

# Introduction

## *The audience for the review*

The topic of e-Learning is of key interest both within education and industry. The UK government's consultation document 'Towards a Unified e-Learning Strategy' discusses a 21st century education system that incorporates strategic actions to embed e-Learning across all sectors. However, the Department for Education and Skills (DfES) acknowledge that they have very little compelling evidence of the effectiveness of e-Learning. The Eduserv Review was established to explore the following research question:

> 'How compelling is the evidence for the effectiveness of e-Learning in the post-16 sector?'

This document will be of interest to the DfES, UK government related bodies such as Becta, LSDA, JISC, HE Academy, HEFCE, NHS Institute for Innovation and Improvement and to others in the international education or commercial sector who are developing an e-learning strategy and so interested in

- What works and does not work in e-Learning?
- How we know that it works or does not work?
- What factors influence how well it works?

The DfES's 2005 e-strategy document includes the objective 'Opening up education to partnerships with other organisations' and the Learning and Skills Council (LSC) agenda for change specifies looking at how best to meet the workforce skills needs of employers. JISC advocates a strong voice for learners and HEFCE is concerned about enhancing the student experience. Becta and DfES agree that 'the effective use of interactive technologies is absolutely crucial'. LSDA has a quality improvement strategy for post-16 education and training and is particularly interested in the attainment of learners in vocational routes. One of the key issues for LSDA is motivation – so we show how this is assessed and affected by e-Learning. The DfES argue that 'traditional teaching methods and e-Learning can and should complement each other' – we document examples of how this blended learning works and what factors influence how well it works. The HE Academy propose a 'holistic approach to embedding e-Learning in institutional activities' – so we look at the implementation of e-Learning at the organisational level. The NHS Institute for Innovation and Improvement seek ways to develop effective learning systems to accelerate organisational and individual growth –so we explore the implications for how e-Learning is embedded at the organisational level. We agree with DfES that 'we need a new understanding of the pedagogies appropriate for a 21st century education system' and this review makes a contribution to this understanding.

It was not possible to encompass the whole of the post-16 sector in this review. Therefore this report focuses on the evidence of the effectiveness of e-Learning for three broad sub-sectors:

1. Undergraduates in higher education
2. Medical students and medical practitioners
3. Work-based Learning.

The decision to focus on these three areas was taken on the grounds that

- Undergraduate e-Learning in higher education is an area that is expanding and many universities are in the process of developing and revising their e-Learning strategies.
- Medical education is an area where e-Learning is particularly well established so that evidence and previous reviews of specific areas are available.
- Work-based e-Learning is guided by principles other than those within the higher education sector and therefore can be contrasted usefully with e-Learning in higher education.

The term undergraduate is used here to describe all students, freshmen, and seniors etc., who are taking part in an undergraduate course at university. This can include distance learners but only if the course is part of a first degree (university qualification). In medical education the population of learners studied is anyone who is using e-Learning in the health sector. Although the focus is still largely on undergraduate students, the review also includes postgraduate medical students, dental students, general practitioners and consultants in hospitals. Learners in work-based e-Learning include employees, employers and managers. In addition, to looking at the impact of e-Learning at the individual level (for the student, practitioner, and trainee), the review also examines the impact of e-Learning at the organisational level.

## *Definitions of e-Learning*

What is e-Learning? Different definitions have been proposed by the three sectors that emphasise different aspects of the concept. We distinguish between definitions of e-Learning that are about the type of learning that is taking place and what is being learned from definitions that focus on the role of the mediating technology and infrastructure. We include example definitions from each of the three sectors below. We note that there is a difference between information and knowledge and this gets lost in some definitions (see further discussion of learning in chapter 2). There are also many other terms that are used to denote e-Learning, including historic terms such as Computer-Assisted Learning (CAL) (see Appendix 1). For instance, in a recent ESRC/EPSRC call for research (2006) the new term 'technology enhanced learning' is used. There can be no single definition of e-Learning that would be acceptable across sectors (or even within sectors) as the context needs to be taken into account. Some definitions of e-Learning, for the three sectors that are the focus of this review, are presented below.

**Definitions of e-Learning in education**

The DfES consultation document 'Towards a Unified e-Learning Strategy' presents us with a broad definition

- If someone is learning in a way that uses information and communications technologies (ICTs), they are using e-Learning (DfES, 2003)

The Learning and Skills Council (LSC) use a DfES definition

- e-Learning is defined as learning with the aid of information and communications technology tools. These may include the Internet, intranets, computer-based technology, or interactive television. They may also include the use of e-technology to support traditional methods of learning, for example using electronic whiteboards or video conferencing.

**Definition of e-Learning in medical education and the health sector**

The Department for Health in a scoping study by SWAP (2003) cite Rosenberg's (2001) definition

- e-Learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance

and point out that e-Learning incorporates (1) formal knowledge and learning resources (2) learning networks (3) contact, administration and assessment (4) information management skills.

**Definitions of e-Learning in the Commercial/Training Sector**

The Training Foundation's definition of e-Learning is

- A learning environment supported by continuous and collaborative processes focused on increasing individual and organisational performance.

'Open Learning Today' (2001) includes a definition of e-Learning by Waller & Wilson

- e-Learning is the effective learning process created by combining digitally delivered content with (learning) support and services.

A definition of work-based e-Learning was proposed in a Becta report (2004)

- The delivery and administration of learning opportunities and support via computer, networked and web-based technology to help individual performance and development, undertaken in or linked to the workplace'.

Some researchers in work-based e-Learning make a distinction between learning and training and suggest that human resource development is moving away from training and towards learning (Sambrook, 2003) and e-Learning is defined as

- Any learning activity that is supported by ICTs

**Working definition for the review**

We have adopted the following definition of e-Learning in this review.

e-Learning is a portmanteau term covering:

- A **style of learning** with a particular focus on technology-mediated interactivity and collaboration.
- The **use of computer technology** in leaning with a particular focus on internet technology.
- The **set of skills** that enables learners to exploit technology in order to develop understanding or capability.

## *What counts as evidence?*

'Research Priorities for e-Learning' (Taylor, 2004) argues that 'e-Learning can take place in all kinds of institutional, social and economic settings and learning contexts and involve a very diverse range of learners…'. As a consequence evaluative evidence about e-Learning is found in a whole host of different journals, websites, conference papers and presentations emanating from a wide range of disciplines. For each of these disciplines the nature of the evidence that is regarded as compelling and the data collection and analytical methodologies that have been used to assess this evidence vary. The evidence can be of very different kinds and qualities ranging from large scale multi-institution studies looking at both process and outcomes, to well-conducted but small-scale laboratory experiments, to more impressionistic studies of individual class or college interventions. We have included accounts from studies of such different kinds and adopted a qualitative rather than a quantitative approach to draw conclusions from them. This is a literature review and no primary data gathering was undertaken.

## *The structure of the review*

This review is in two main parts. The first part consists of Chapter 1 which describes the work with stakeholders that was undertaken subsequently to literature search. So it is chronologically out of sequence, but it provides the key recommendations for stakeholders early on in the document.

The second part consists of the literature review and starts with Chapter 2 on theories of learning relevant to the e-Learning context. In Chapter 3 the methodology used to find studies that provided evidence of the effectiveness of e-Learning is outlined. In chapters 4 to 6 the reviews of undergraduate e-Learning in higher education, e-Learning in medical education and work-based e-Learning are presented. Each of these chapters includes a summary of previous reviews, and presents the evidence for the effectiveness of e-Learning using Kirkpatrick's (1998) levels of evaluation model. Chapter 7 includes a table of key factors that influence how well e-Learning works in the three sectors. Chapter 8 contains a critical discussion of research methodology and evaluation of e-Learning in the three sectors. In chapter 9 the gaps in the literature on the evidence of the effectiveness of e-Learning are identified and recommendations for future research and evaluations are made.

## *Process of the review and post-review consultation*

The initial review was undertaken over a two year period from March 2004 to March 2006 led by Julie Coultas with Benedict du Boulay and Rose Luckin. During this period two expert seminars (May and November 2004) were organized as well as a seminar organised by Eduserv (April 2005). These seminars provided consultation with experts in the field (researchers on e-Learning, e-Learning experts from industry, contributors from Eduserv, DfES, LSDA, JISC, BECTA, HEFCE).

Finally, Rose Luckin and Benedict du Boulay took the findings of the modified systematic review of the literature and presented them to a *Roundtable* of international e-learning experts at the e-learn conference in 2006. This generated useful observations and additions to the outcomes of the review which Rose Luckin and Benedict du Boulay then presented as an issues paper at a workshop (February, 2007) with a group of senior academics and policy professionals. The purpose of this *workshop* was to review the findings and identify key research and policy issues that emerged from the work. Following these later activities the initial review was revised for November 2007 in the context of the 'Harnessing Technology: learning in the 21st century' policy initiative led by Becta. This initiative engaged a wide community of participants in a series of invitation only Policy Seminars the outputs from which will be used to inform the Governments revised e-strategy.

**Key findings of the Roundtable**

E-learning requires a different mode of learning, which was characterised as "independent learning", and changes the combinations of Space, Time and Money necessary for learning to take place. Teachers are beginning to get insights in how to use "timely interventions" to deal with the attendant mix of "theorising and socialising". Institutions, however, are not yet equipped to modify the ways that they deal with these factors not least because key performance indicators (KPI's) map to traditional learning outcomes.

**Key findings of the Workshop**

"e-learning" is no longer a subset of learning used in distance learning and has evolved into "learning in technology-rich environments" which occurs in multiple contexts both within and beyond the institution. With technology and learning developing rapidly, but independently, we have the capability for the co-creation of learning through the integration of the range of technologies available for learning. Institutions however need to move away from the use of simple KPI measures to focus on quality improvement

**Key findings of the review**

It is difficult to talk simply of e-learning and then to measure how effective it has been as e-learning is a dynamic as the subject is both complex and ever-changing. The review identified definitional elements, key factors in e-learning, how to measure effectiveness and whether the research was examining right issues. Relevance to institutions, work-based learning and health were also reviewed. Definitions were identified as containing three components; skills, computer technology and style of

learning. Key factors in e-learning were identified as being learner confidence, prior knowledge (both operational and conceptual), the presence and involvement of the Teacher, communication (the dialogues between teachers and learners and the cultural issues relating to managing change. This level of detail in itself identifies the complexity of the field under review and yet both the complexity of the definitions and the number of key factors were added to through the review expert review process.

**Conclusion**

In carrying out this work we have tried to pull together the findings into a form that will be useful to a range of academics and professionals working in education. The review has identified a raft of policy and research issues that need to be acted on which develop from the finding that we are at the end of e and are now learning in technology-rich environment. These are recommendations which can be acted on by a range of institutions, agencies and government departments.

The Reveel website provides access to the review consultation documents, seminar reports, conference presentations and references for papers that were included in the review, as well as this document.

**http://www.reveel.sussex.ac.uk/**

# 1: Post-Systematic Review Consultation; the emerging Policy and Research Issues

**Introduction to the Chapter and its purpose**

This chapter summarises the work carried out since the completion of the REVEEL Systematic Literature Review (which starts at Chapter 2). The purpose of this work was to take the findings of the Review and use them to engage in an iterative debate with key academics and policy makers to evaluate the relevance and usefulness of the findings.

**Iteration Round 1: The International Perspective**

This process of iteration commenced with a summary of the outcomes of the original REVEEL Review being submitted to the International e-learning conference: e-learn 2006 in the USA. This ensured that an International group of e-learning experts could consider and debate the findings of the review at a Roundtable.

Part 1 of this chapter presents the summary document presented to that Roundtable and the subsequent discussion. The Roundtable debate and outcomes were fascinating; in essence the discussants agreed with the Review findings but also extended and elaborated upon them. Two key considerations were suggested: firstly that e-learning changes the mode of learning and promotes learning discourses, which continue beyond the institution; and secondly that as e-learning develops the Key Performance Indicators that drive institutions are increasingly seen as blockers to its development. KPI's measure traditional learning outcomes and e-learning is transformational.

Part 2 of this chapter presents the findings from the Roundtable as they were summarised in readiness for the next iteration of debate.

**Iteration Round 2: The UK Perspective**

This next iteration was with a group of UK academics and policy makers. The Roundtable findings were presented to an invited group of academics and policy makers at the London Knowledge Lab in January 2007. The purpose of this second event was to both review the outcomes of the Roundtable in terms of relevance in England and to identify emerging Research and Policy issues. Part 3 of this chapter contains a summary of both the outcomes of the Workshop debate and the postings on the wiki used to support and extend these discussions.

**Iteration Round 3: The Policy and Research Issues for the UK**

As a result of the International discussions at the Roundtable and the UK workshop key research and policy issues were identified. Part 4 of this chapter summarises these research and policy issues and provides an analysis of the agencies that might be interested in them.

During Autumn 2007 these outcomes have informed discussions in the Becta Next Steps e-strategy Policy consultation process. The relevance and useful of these emerging issues has been clear, in particular with respect to growing concern with learning in multiple contexts and how that can best be supported. The Becta work has the opportunity to feed into reviews of KPI's and PSA in Education Departments and needs to be engaged with further. Part 5 of this chapter provides a summary of the overall post-review process with brief recommendations for future work.

## Part 1; the e-learn 2006 Roundtable Discussion Paper

This section reproduces the e-learn Roundtable paper, which began the Consultation process on the findings of the REVEEL Review. The subsequent outcomes and issues all emerge from this paper so this is seen as setting up the discussions from which the Research and Policy issues and concerns at the end of the chapter are drawn.

## 1. Introduction

This paper gives a brief overview of this work. The roundtable discussions at e-learn 2006 will allow us to elicit feedback on these from International stakeholders and thereby enrich the review. In this paper we offer an initial definition of e-learning and discuss the subject areas of Work Based Learning, Undergraduate Education and Medical Education. We offer a different approach to the discussion of each in order to provide something that is relevant to as wider audience as possible and in this way to provoke discussion of the key emerging issues at the roundtable event. With respect to Work Based Learning we discuss the scope of our review, its audience, and what needs to be done next. For Undergraduate Education we offer a contextualized case study and for Medical Education we give a brief summary of its special nature.

***Questions that we hope will contribute to the round table are emboldened and bordered.***

## 2. Do we have a good Definition of e-learning?

During the review many definitions of e-learning were found, for example in the commercial and training sector some researchers make a distinction between learning and training and suggest that human resource development is moving away from training and towards learning (Sambrook, 2003). In this context e-Learning is defined as: Any learning activity that is supported by ICTs. Within formal education, the Department for Education and Skills in England and Wales has offered a broad definition: "If someone is learning in a way that uses information and communications technologies (ICTs), they are using e-Learning" (DfES, 2003). Within medical education and the health sector the Department for Health cite Rosenburg's (2001) definition: e-Learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance (Department for Health, 2003).

These varying definitions of e-learning focus on different issues. Some are concerned with the technology used by the learner(s), varying from specifically "internet" technology to generally "information and communication technology". Others focus on the kinds of interactions that learners have with systems, stuff and other learners: "continuous and collaborative processes". Others again focus on outcomes e.g. "enhance knowledge and performance". Each of the definitions has its merits, but none quite hits the mark. As part of our initial consultation with a variety of experts we developed the following definition: e-Learning is the capability required of learners/users in order that they can manage their own learning in the 21st century, using technology as appropriate to context, sector and task (May 2004). At the end of the project we offer the following definition for discussion at the roundtable event:

*E-learning is a portmanteau term covering:*

- The **set of skills** that enables learners to exploit technology in order to develop understanding or capability;
- The use of **computer technology** in learning with a particular focus on internet technology
- A **style of learning** with a particular focus on technology-mediated interactivity and collaboration

***Point for discussion at the roundtable: Is this a good definition?***

## 3. Where and what is the evidence about the effectiveness of e-learning?

The evidence that can be found within journals, websites, conference papers and presentations across numerous disciplines offers a vast range of types and qualities of evidence. There are large scale multi-institution studies looking at both process and outcomes, well-conducted but small-scale laboratory experiments and more impressionistic studies of individual class or college interventions. Disciplines vary with respect to the evidence that is regarded as valid. Likewise, data collection and analytical methodologies vary. But, what evidence should we count as valid?

We chose to prioritize empirical evidence when it was available. The evidence that we included in the review fell into two broad classes both of which may be focused on the learners themselves or on the learning situation and context:

- Evidence about outcomes: For example, evidence of learners developing particular capabilities or institutions having met particular targets. Evidence may be comparative to other non e-learning methods. This type of evidence may also be concerned with the indirect effects of particular learning experiences. For example, that the learner shows greater propensity to engage in further learning experiences after completing some e-learning.
- Evidence based process measures: For example, that learners are able to engage in experiences and behaviours that they would not be able to in other situations; or that the roles of teachers are changed.

***Point for discussion at the roundtable: What should count as evidence?***

## 4.The 5 Key factors that influence how well e-Learning works in the three sectors reviewed.

The review suggests that there are 5 keys that institutional and contextual factors that will always have an influence on the success of e-Learning. Overwhelmingly, it is the human factor rather than the technology that matters. On the individual level:

1. The confidence of individuals in their own abilities when engaging in e-Learning is crucial

2. Prior knowledge at both the operational level (how to do it) and the conceptual level (understanding) is important

On the social level:

3. The presence and involvement of a teacher/trainer can have an impact on how well e-Learning works
4. Communication - the continuing dialogue between the teacher and the learner and also between learners is important
5. Tutors, faculty members, and fellow workers can have an influence on the adoption of new technologies through role modelling and social learning

***Point for discussion at the roundtable: How generalisable are these 5 factors??***

## 5. Work Based e-Learning
## What does this survey cover?

The survey covers a literature review of Work-Based e-Learning (WBeL) and then provides an analysis of what can be learnt from that review. However this provides a partial picture of the effectiveness of WBeL focusing on those issues covered by research. This leaves both gaps and a lack of clarity, particularly, in terms of definitions and WBL contexts, but provides useful information on key issues. The research is particularly strong in identifying the range of issues relating to the learner in WBeL. Issues to do with experience, motivation and barriers as well as relevant approaches to learning are covered well. This research allows us to identify five key recommendations on aspects that need more research.

## What this survey doesn't cover

The lack of broad-ranging research on both Work-based e-Learning and Work-based Learning (WBL) means several issues are not covered. For example the overall purpose of WBL isn't clear; various relationships have been hypothesized by researchers in providing a framework for their research, but this doesn't provide a consistent framework we can map to. Work-related knowledge and skills in this country are typically seen as something that the employee brings with them or learns on the job

Issues about the nature of the organization in which WBeL takes place aren't addressed. Is the organization a knowledge organization, or a learning organization? In which case Learning, Information and Knowledge would be key HR concerns and allow for coherent provision.

***Point for discussion at the roundtable: What are the important issues for Work Based Learning that need to be included?***

## Who might be interested in this survey in the UK and why?

1. The Learning and Skills Council: the main funder of work-based learning, who also have government, targets to deliver in terms of Skills for Life
2. Sector Skills Councils: who have a responsibility for defining the skill sets of employees in various industries and the developing sector-based Academies (such as the Retail Academy) who provide resources for meeting these vocational requirements.
3. The Association of Learning Providers: the professional organization of WBL providers who are currently developing generic WBL e-learning strategies for their members
4. The University for Industry (UfI): the main providers of online work-based learning resources through learndirect, and have developed many strategies to maximize take up of WBeL.
5. The Quality Improvement Agency (QIA): who have the remit for improving the quality of learning across all Post-16 provision, including WBL.
6. Adult Learning Inspectorate: who have the responsibility for reviewing all learning provision against the Common Inspection Framework. This will continue after their integration with OFSTED.
7. The Department for Education and Skills: who have the responsibility, through the e-strategy, for integrating WBeL into all Post-16 e-learning by 2010.
8. Organisations such as Knowledge Base who are being developed as the national "experts" on WBL.

***Point for discussion at the roundtable: Internationally, who are the interested parties and what is their interest?***

## Future work

These conclusions and recommendations need to be developed and analysed against other sources of information about WBL and WBeL. In many ways Work-based e-learning is only beginning to be taken seriously by policy makers now that the e-strategy is concerned to treat all aspects of e-learning equally and to provide system-wide integration. In Post-16 education this is taken to mean the integration of Further Education, Adult and Community Learning, Work Based Learning and Offender Learning. EU i2010 has targets aimed at both the transparency of education across Europe and the integration of formal, non-formal and formal learning. This requires WBL to integrate into formal provision. A key driver in this is the UK Government's target that everyone should attain Level 2 qualifications (which has recently been extended to include Level 3 targets). For this national target to be achieved many employees need to develop their qualifications and the government will need new strategies for promoting WBL. Learning from effective WBeL can help in this endeavour.

***Point for discussion at the roundtable: What are the international Drivers?***

## 6. Undergraduate Education: a contextualized case study

This case study describes an institutional decision making process about the need to invest in e-learning. Our review needs to offer institutional managers and policy makers clear information about why they should invest money in e-learning and what is likely to best meet their needs. Through this case study we highlight the issues that are pertinent to this audience. The institution used as the case study has made little investment in e-learning to date and is wanting to make a decisions about what it should do next. They are operating in a context where the Higher Education Funding Council have highlighted the needed for institutions to develop e-learning strategies and have allocated some resources for this purpose.

## Why should an institution invest in e-learning?

Investment in e-learning could help the institution to:

- Achieve its Institutional aims
- Address Key Performance Indicators such as: student satisfaction levels and students Employability.
- Catch up with similar institutions and reposition itself. Not doing this could impact on their ability to attract the students they want
- Staff and students are eager to engage and move forward and can enable substantial gains in teaching and learning quality and satisfaction.
- Helps the institution to modernise and is consistent with other investments.

***Point for discussion at the roundtable: What type of information could help this institution decide to invest?***

## What does the institution know about itself?

Our case study institution conducted extensive consultation and research to ensure that it understood the nature of its own e-learning context. This consultation exercise and research included:

1. Evaluating the readiness of the institution for e-learning through a staff audit. Overall Staff felt that the institution was "emerging" into readiness, but there were interesting differences between what the managers believed to be available in the institution and what staff and students believe to be available.

2. A questionnaire to explore what staff and students understood about e-learning and what their priorities were. This indicated that teaching staff wanted to have access to a wide range of learning technologies, targeted support for teachers to integrate ICT into their courses for use with students and more effective computing support. Students prioritized on-line access to course materials (i.e., lecture slides, reading lists, journals and books) and would most

value the aspects of E-Learning that could be provided via an e-Learning package.

3. Creating a draft e-learning strategy for the institution: an initial small group of staff from different units created a map of the activities they normally complete in order to support teaching and learning. These activities were matched to potential technologies and used as the basis for scenarios about life at the institution. These scenarios were used to create an initial vision for an institutional strategy and to engage staff and students in the creation of a shared vision. Results of the consultation on this draft strategy confirmed that the e-learning vision at the heart of this strategy was appropriate.

The consultation revealed that the priority should be to support the needs of faculty and students in the use of E-Learning tools.

***Point for discussion at the roundtable: How can the institution evaluate the extent to which this priority has been met?***

## A day in the e-enabled life of an undergraduate… a vision scenario

"Arthur is spending his morning at home. After some serious kick-starting caffeine consumption, and distraction activity e-mailing his friends back home, he gets down to work. The previous day's session on campus had been very interesting. Karen, his lecturer, had engaged his group in an on-line discussion with Ted, her colleague, who was working in the Antarctic collecting data about the changes in the ice thickness of a lake. They had all been able to chat with Ted, and ask questions, using ichat or messenger. Everybody could see the discussion and join in via their tablet PCs. The data from the fieldwork that Ted had been conducting was displayed on the large interactive whiteboard in the seminar room, so that it could be referred to during the discussion.

Following this classroom exercise, Arthur is now spending his morning engaged in some on-line group-work. As a visiting student, he's been really pleased to get involved in some intensive shared work: he feels that he wouldn't have gotten to know British students in the same way without it – though he still finds their sense of humour weird! He has a problem worksheet to peer review. He downloads the worksheet and the model answers he's to use to give his fellow-student feedback on their work. He doesn't know whose work he's looking at: the system allocates anonymised scripts at random. He finds it really interesting to see how other students have tackled the same problems as him, and likes seeing the model answers as well. There's always a bit of good-humoured groaning about having to do this job every week – but he knows that he wouldn't really look at the model answers properly otherwise, and he's feeling pleased with himself at his much better than usual ability to get through the worksheets – so something is obviously working! In any case, right now he's itching to see how to do Question 7, which had stumped him completely and has been bugging him ever since."

***Point for discussion at the roundtable: Is this what e-learning should be like for undergraduates? How can institutions know if it is effective?***

## 7 The Special Nature of Medical Education

It is not our intention to focus discussion on Medical Education at the roundtable event. However, there are several special features about medical education and the effects of e-learning that are worthy of note. First, the students are largely highly motivated and want to achieve the understanding and skill that will enable them to "qualify" or do the job better. Second, medicine usually provides a technology-rich context so learners will be used to dealing with (not always well-designed) technology of all kinds, including learning technology. Third, much medical learning is undertaken "on the run", in the evening, in breaks and indeed "on the job". Finally medicine is a profession and one where mistakes really matter so the standards of skill, understanding and behaviour are monitored. These features all contribute to setting a context for e-learning which is likely to be different from, other contexts.

***Point for discussion at the roundtable: What evidence can we use to evaluate the impact of context?***

### *References*

Department for Education and Skills (2003) Towards a unified e-learning strategy Available at http://www.dfes.gov.uk/consultations

Department of Health (2003) Building E-Learning Capacity for the Social work Degree A Scoping Study for the Department of Health E-Learning Steering Group Available at http://www.doh.gov.uk/swqualification

Rosenberg, H., Grad, H. A. & Matear, D. W. (2003) The effectiveness of computer-aided, self-instructional programs in dental education: a systematic review

Sambrook, S. (2003) e-Learning in small organizations. Education and Training, 45 (8/9) p 506 – 516 of the literature.

## Part 2; Issues emerging from the Roundtable Discussion.

**Introduction**
This section covers the debates and the issues that emerged from the Roundtable Discussions held at the e-learn 2006 conference on Sunday October 15. Despite an earthquake 3 hours before the session it was well attended with 15 researchers and practitioners involved. Roundtables are debates, which anyone at the conference is free to join in. In this case a paper was submitted which was available for participants to read before the session. During the session a number of key points were re-iterated and used as the basis for discussion. These were

- Possible definitions of e-learning
- Evidence about the effectiveness of e-learning
- 5 key factors influencing e-learning effectiveness
- Work-based e-learning
- Universities and e-learning

**Process**
During the roundtable the chair used the issue of definitions of e-learning to open up the debate and then move through the five key points listed. The focus of the debate was on definitions of e-learning, the key factors and the university context. From which the nature of research evidence was debated. Due to time constraints, and the expertise of those involved, work-based learning was not discussed. Participants came from the USA, the UK, Canada, Australia, Germany, India and included representatives of Carnegie-Mellon and Stanford Universities.

**General Issues about e-learning emerging from the roundtable**

*e-learning and prior learning assumptions*
Learners arrive at e-learning with their own set of assumptions concerning;
a) Learning processes, which depend on how they have been schooled previously, and are usually based on formal "stand and deliver" models
b) Communications, which are often based on how they have communicated in social contexts previously
So learners come to e-learning, which has a different combination of factors relating to how learning is delivered as well as a strong communications component, with assumptions about learning (often focussed around "learning drills") that are inappropriate to this new learning context. They often come with limited expectations concerning academic discourse and are not initially equipped with an understanding of the subject discourses or the communications modes (and "netiquette") appropriate to that learning discourse in terms of subject, level and context.

*Independent Learning*
Overall e-learning was seen as being about learners taking responsibility and becoming independent learners. However it was seen that in every learning context a set of ground rules need to be established and that these rules worked best when the learners

have some input into them. So e-learning was viewed as working most effectively when **co-creation of the learning process** was involved. In addition the question of the role of the teacher and the role of authority in the e-learning context was debated. The teacher's role as, variously, facilitator, broker, moderator, designer or animateur was discussed without any clear or precise conclusion being arrived at. However it was the consensus that teachers roles change significantly in e-learning contexts. This needs examining in more detail.

## Definitions

*Issues in the Research Document*
The definitions emerging from the Literature Review focussed on three elements common to all definitions; a set of learner **skills**, the use of computer technology and a **style** of learning which is mediated and collaborative. The participants at the roundtable agreed with these but very forcibly added a fourth element to what constitutes the definition of e-learning after considerable discussion. This concerns the element of **communication**, particularly as we are asking learners to operate in a non-face-to-face environment. This took on a number of aspects;

a) e-learning provides new and additional ways of communicating
b) e-learning require rules, guides and cues for behaviour
c) Mixed groups come with differing assumptions about communication.

The discursive and research-based nature of typical e-learning (see below) requires much communication of various kinds which learners need guidance with, especially in terms of understanding formal and non-formal approaches to communication. Additionally learning groups often have members from many different cultures who have different assumptions concerning learning and communication.
Much discussion focussed around the concern that communication in e-learning is often a mix of **"theorising and socialising".** Dealing with this, and scaffolding these discourses into learning processes, is a key skill for the teacher. Many strategies were suggested to address this, but with a focus on understanding how to structure "**interventions"** in the communications processes of e-learning.
In discussion the key contextual factor to be aware of concerning communication was identified as audience awareness, and the necessity of understanding the appropriate "genre, register and tone" for that audience.

## Research Evidence

The prompt for this discussion was the question about whether we should be looking at research about **outcomes**, that is using evidence about the traditional measures of the effectiveness of learning, or research about **process**, that is using evidence concerning the transformational aspects of e-learning.
An animated discussion amongst the participants at the roundtable arrived at the unanimous view that e-learning was **transformational** and that if we are to

understand its educational effectiveness we need to take long-term views and gather longitudinal data. In the main research is less interested in this approach.
The participants took the view that the key point is that learners change their **mode of learning** in e-learning. They no longer memorise and cram for exams, but they expect to take a "research-based" approach; finding sources, testing for validity and applying the information they find in answering problems that they are trying to solve. The communication dimension of learning is expanded and they are actively involved in applying their learning practically and demonstrating that they have learnt facts and their relevance.

*Summary on evidence*
Research needs to look at the transformational nature of e-learning and how it affects the process of learning rather than mapping it to traditional outcome measures.

**Five Key Factors**
The participants were prompted with the findings from the literature review of the **five** key factors reported in the research literature;
a) Learner Confidence
b) Prior Knowledge (operational and conceptual)
c) Presence and involvement of the Teacher
d) Communication; Dialogue between Teacher & Learner and Learner
e) Cultural Issues relating to Managing Change
This generated some debate and much agreement. However it then highlighted **two** further key factors in the view of the participants.

Firstly was the complex issue of **motivation**. As discussed above e-learning was seen as being about responsible independent learners. Yet learner's expectations on coming into new e-learning contexts were based on traditional "schooling" methods. So in order to affect this "transformation" motivation was seen as key and was identified as having two dimensions, one for the learner and one for the teachers. The first dimension relates to the observation that the learner's awareness and **aspirations** need to be raised so that they understand learning to be about setting their own goals and developing learning strategies for meeting them. Secondly teachers have to provide more varied and interactive learning strategies and resources in order to **stimulate** the motivation of learners.
Secondly, it was identified that that a consistent **platform** and a minimum technical offer from the learning institution was required to underpin everything else relating to e-learning. So as well as the revised Learning Contracts discussed below (in the section on Universities) a Service Level Agreement around the technologies used were also highlighted.

**Universities and Institutional Issues**

*Institutions and Key Performance Indicators*
Institutions were seen not as enablers of e-learning but as blockers. They were clearly identified as failing to provide support for e-learning developments, even when they

had requested them. For example, let us consider the earlier point that e-learning involves a degree of co-creation and that consequently the teacher's role changes and becomes dynamic within the e-learning process. Unfortunately institutions tend to see learning as a static process and don't allow for dynamic developments in the learning process. One participant reported being moved off an e-learning course once she had developed its initial form. The institution saw the course as having a new but fixed design in its e-learning formulation which any instructor could then come in, pick up and deliver, but they failed to see the qualitative differences asked of the teacher, which in fact require new skills in practitioners.
Institutions are typically using traditional Key Performance Indicators (KPI's) to evaluate the effectiveness of e-learning. For example student satisfaction is typically measured using traditional evaluation forms designed to measure traditional face-to-face learning contexts; so quantitative evaluation measures are based on qualitatively different learning processes and contexts.
Institutions are still seeing e-learning primarily as delivering institutional efficiency gains.

*e-learning and "Compliance Courses"*
The role of "compliance courses", e.g. ethical, legal, Health & Safety and similar courses, often offered on a pass/fail basis, were often seen by institutions as being ideal for e-learning delivery as it could be quantitatively demonstrated that students had **seen** the relevant material. This lowered the quality of both the course itself and the e-learning delivery.

*Learning Contracts*
The issue of learning contracts was discussed in a number of ways. Participants felt that in agreeing ground rules for learning in e-learning contexts they developed a revised "Learning Contract" on the part of BOTH the Teacher and the Learner. This raised the issue of revising the Learning Contract between the Institution and the Learner, especially in terms of the range and variety of learning pathways offered to the Learner. A broader range of "roll-on roll-off" strategies were seen as being needed, bearing in mind the necessary constraint that learning is a social process and needs support and guidance (if learning communities are to be built and sustained).

***Summary of issues about e-learning emerging from the Roundtable***

The view advanced overall was that e-learning **changes the combinations of Space, Time and Money** necessary for learning to take place and whilst teachers are beginning to get insights into how to deal with this, institutions are not equipped to modify the ways that they deal with these factors.

## *Part 3; Issues emerging from the Eduserv Workshop 2007*

This section takes us into iteration 2 of the post systematic review debate. It contains a summary of the issues emerging from further discussions at a UK workshop held in January 2007. The process supporting the workshop was somewhat different to that used for the International Roundtable. A wiki was set up in advance of the event with the Roundtable paper (as presented in section 2 above) plus other associated resources. This was made available to attendees before and after the event (http://eduserveffectiveelearning.pbwiki.com/). Attendees came from JISC, the HE Academy, QIA, Becta, Kings College London, Oxford Brookes University and the University of Sussex. The issues captured below represent a synthesis of the debates both on the wiki and at the Workshop.

### *Introduction*

A workshop was held at the London Knowledge to review the issues emerging from the Roundtable discussion at e-learn 2006 which itself was convened to review the overall findings of the eduserv REVEEL project. This was a longer and more focussed discussion than the Roundtable and was also supported with a wiki where comments could be made both before and after the actual half day workshop. These comments have been incorporated into this section.

The brief for the senior academics and policy professionals who were invited was to review the paper which was produced after e-learn 2006 summarising the issues emerging from the Roundtable at the Conference. Participants were pointed at the original research website but we used the "Issues" paper to frame both the workshop discussions and the structure of the wiki. Participants were asked to review the issues emerging in terms of three key criteria;

a) relevance and appropriateness for England
b) identifying possible research agendas
c) identifying possible policy agendas

The conclusions given below follow the structure of the paper on "Issues emerging from the Roundtable".

### *Information obtained at the Workshop*

Most of the discussions in the workshop tended to move first to broader themes rather than immediately addressing the specific theme and question posed. It is the conclusion of the authors that this came from the fact that the information being provided was both a couple of years old, and that the outcomes of the e-learn Roundtable had a bias to the University experience in the US. Consequently attendees were re-phrasing the framing question to broaden the debate and bring it back into their own UK experience.

They were also asked to identify Research Issues and Policy Issues in each of the debates wherever possible.

## *Workshop discussion on "General Issues"*

The discussion on general issues, which concerned both "prior assumptions about learning" and "independent learning", occurred in passing as the overall context of the discussion on the effectiveness of e-learning was established. This discussion was mostly concerned the key workshop theme that we are coming to the end of "e-learning" as a subset of learning so we need appropriate preparation for learning in all its forms. This overall concern with learning was partly addressed by the contention that both Learners and Practitioners need to be prepared for "designing for learning" in multiple contexts. So "prior assumptions" about learning brought by learners into new learning contexts are seen as constantly evolving. The current situation is complicated by the behaviour of what Oblinger calls the "net generation" (see http://www.educause.edu/content.asp?PAGE_ID=5989&bhcp=1) and the observations found in the DEMOS review "Their Space" which describes the styles of young people in using new technology (see http://www.demos.co.uk/publications/theirspace).

So there is a need to prepare learners for the "independent learning" characteristic of "e-learning" which could be addressed through training for "designing for learning". It was argued that preparing practitioners and learners to "design learning" would enable a formalisation of the co-creation of learning processes, which is a possible Research Issue. It was also argued that the co-creation of learning could come from the dynamic use of formative assessments even though these aren't the only processes of learning. This was tempered by the observation that learning "doesn't stop at institutional boundaries", so a further set of contextual issues would also need to be addressed (a potential Research Issue).

This kind of technology-enabled "design for learning" (which can be seen in Learning Design tools such as LAMS) appears to place greater professional demands on practitioners as they need to be capable of supporting learners whilst taking on an ever widening range of roles. A concern was raised that current Initial Teacher Training (ITT) and Continuing Professional Development (CPD) does not support this differentiation of practitioner skills (a potential Policy Issue).

In response to a prompt concerning the observation from the LSDA "Innovations in Learning" Project that it takes practitioners 3-5 years to fully develop their skills to support learning effectively there was general agreement that such a practitioner development process would take time and some carefully designed CPD to support this would be necessary. The descriptions of "the teacher's role" in the discussion document as, variously; facilitator, broker, moderator, designer or animateur was approved of. This raises a Policy Issue of how we prepare practitioners to be effective in each of these newly emerging roles.

## *Conclusions on the "General Issues";*

The starting point for this discussion was the finding that learners arrive at new learning contexts with "prior learning assumptions" which will shape their learning behaviour in the new learning context. E-learning requires a different mode of learning,

which was characterised as "independent learning". The following points expand on these two "general issues".

1. We are coming to the end of a period where we can have a separate focus on e-learning so the clearly delineated separation of e- and non-e prior learning assumptions is changing and become less clear and less easy to define.
2. The nature of prior learning assumptions is changing (ibid see DEMOS "Their Space" for a list of characteristics of technology adept young people) and learners may already be technologically proficient in using web-based and new technology tools to support their learning, but in ways that do not match to the expectations in the new learning context.
3. The changing nature of teaching and learning, as well as the "prior learning assumptions" that learners arrive, with all require new roles for both learners and practitioners. Both learners and practitioners need to be aware of this and may need to be able to be capable of "Design for Learning" to deal with this (see the JISC research programme into this http://www.jisc.ac.uk/whatwedo/programmes/elearning_pedagogy/elp_designlearn.aspx)
4. Independent Learning, that is being responsible for ones own learning, and is promoted by "e-learning" affords the possibility for the co-creation of learning. It was argued that this is best enabled through the use of "formative assessments" which have been found to be very effective in e-learning.
5. The notion of "Independent Learning" itself should not be seen as stopping at institutional boundaries; learning occurs in multiple contexts and learning across all relevant contexts needs to be designed for.
6. Finally it was agreed that practitioners' roles are developing and changing and the description that they need to be "facilitator, broker, moderator, designer or animateur" was agreed with strongly.

## *Workshop discussion on "e-learning definitions"*

The workshop debate on e-learning definitions was triggered by the question of whether the "theorising and socialising" identified in the e-learn Roundtable summary document was simply a description of how discussion normally occurs in learning, or whether in e-learning a greater number of cues and processes of differentiation need to be identified by the practitioner in order to scaffold learning experiences through the discussions developing in the e-learning context?
The definition, which started with a broader acceptance of the constructivist approach to learning that it implies, was welcomed. However concern was expressed that understanding the varying mixes of "theorising and socialising" around learning need to be understood for every context in which learning takes place; the multiple contexts of learning being a theme of the workshop.
The question was then raised regarding this conversational concern as to whether the "communication interventions" by practitioners needed are the key to effective e-learning? The notion that a singular intervention in clearly defined communications

processes was all that is needed was challenged with the observation that we "don't know where conversations about learning take place". This was not to gainsay the importance of understanding how to use these conversations about learning but rather that they exist in multiple contexts and consequently are complex and raise a research Issue.

The debate moved on to the question of what is the definition of e-learning? It was argued that whatever definition you come up with someone will challenge it. For example the way the element concerning computer technology was described was seen as being too restrictive, all digital tools and processes need to be included. This was used to elaborate the point that we are at the end of "e" and to differentiate learning and e-learning is arguably no longer fruitful, which is very much a research and policy issue. It was proposed that we are now "learning in technology-rich environments" so we are arguably in a new post-e world of learning. On reflection this is a powerful and seductive argument and certainly points to many possible future research agendas. From the policy perspective this is less fruitful as a definition allows for and enables funding. Do we rather need a new definition of Learning. Is the real issue actually about achieving effective Quality Improvement in learning "in technology-rich environments" rather than just what is effective e-learning?

## *Conclusions on the Definitions of e-learning*

The Research identified that definitions focussed on three common elements: a set of learner skills, the use of computer technology and a style of learning which is mediated and collaborative, but the Roundtable wished to extend this and added a fourth element: communication. This was further developed in the workshop.

1. The use of a constructivist definition "scaffolding discourse into learning" was welcomed as a definitional step forward from the Roundtable.
2. This constructivist idea of learning, deriving from the observation of learning being a mix of "theorising and socialising", needs to be applied in the multiple contexts of learning (as indicated above).
3. The notion of a model of practitioner "intervention" in "learning discourse" was welcomed but that model needs to be enabled so that it can be applied across the multiple, formal, non-formal and informal contexts of learning.
4. The use of a definition based on learner skills, style and communication was accepted but the element concerning computer technology needs to be extended to account for all digital tools and processes
5. In line with this more complex and richer definitional model a crucial point was made that definitions used in the future need to be about "learning in technology-rich environments", rather than "e-learning". This is similar to the original REVEEL definition, from the initial expert seminar.
6. Further to this developed definitional point it was also noted that if we wish to measure effectiveness then it needs to be looked at in terms of the relationship between "learning in technology-rich environments" and overall quality improvement in educational provision.

## *Workshop Discussions on Five Key Factors*

The original REVEEL research had identified 5 key factors: Learner Confidence, Prior Knowledge (operational and conceptual), Presence and involvement of the Teacher, Communication; Dialogue between Teacher & Learner and Learner, and Cultural Issues relating to Managing Change (See e-learn Roundtable summary paper).
The Roundtable discussions had added two further key factors: motivation and a consistent learning platform.

The debate at the UK workshop started with the question of whether the HE Academy's observation of "Hidden Learning Environments" means that no institution can provide a consistent learning platform and the suggestion that Web 2.0 tools are changing the way learners use technology.
This was taken to support the earlier call regarding the necessity to show learners and practitioners how to "design learning" as opposed to being shown how to use specific learning platforms (which reflects the greater flexibility in e-learning use in the UK). This was argued as being achievable through the process of integrating learning into platforms (not VLE's per se more in the sense of the CETIS Personalised Learning Platforms specification as an aggregation of tools, rather than an application, recognised by institutions ). In addition to this the concept of multiple conversations about learning occurring in this "underworld" of Hidden Learning Environments and the need to understand the role of informal learning was also highlighted, both are possible research and policy issues.

Two additional points were raised in the debate about Key Factors:

1. The relevance of the first four factors (Learner Confidence, Prior Knowledge, Presence and involvement of the Teacher, and Communication) was confirmed as they produce the learning process. However, the workshop felt that it would be difficult to measure all of them in assessing "effectiveness". The fifth factor: Cultural Change, was not seen as being a factor in e-learning but something necessary for effective e-learning to become embedded in institutions.
2. In terms of making e-learning effective then the value of "course redesign", perhaps over a period of three years, was proposed as a way of ensuring that the cultural change necessary for effective e-learning could be introduced.

Intrinsic learner motivation was seen as a key to transformational learning which is not to deny that teachers have a very important role in inspiring learning. However the "plurality of techno micro cultures" in which learning now occurs was seen as setting significant challenges for institutions

## *Conclusions on the Five Key Factors*

The workshop was broadly in agreement with the five key factors identified in the Research and the further two factors added by the Roundtable, but wished to construct them differently.

1. It was agreed that the four of the five original factors of confidence, prior knowledge, involvement of the teacher and communications were key factors in "e-learning" and could be used to develop a description of a necessary learning skill set.
2. However cultural change and stimulating learner aspirations were seen as being contextualising factors to this skill set and were about enabling learning in context (learning in technology-rich environments as identified above) and these factors could be addressed through quality improvement in provision.
3. Consequently it was argued that there existed the possibility of extending the concept of "Designing for Learning" between learners and practitioners to involve learners in Course Design itself over a period of time. This would both address cultural change and stimulate learner aspirations through the co-creation of learning in technology-rich environments and was seen as a way of developing the lessons learnt from effective e-learning.
4. The possibility for Learning Contracts could be used both as a way of formalising the expectations in co-creation and as identifying a minimum technical expectation.

### *Workshop Discussion, Institutions and Key Performance Indicators (KPI's)*

The following question provoked a very wide-ranging discussion concerning KPI's, quality development and institutional e-maturity relating to effective e-learning: "if institutions are happy in meeting KPI's is there a role for "self-assessment reviews" as part of a lighter touch inspection regime in broadening approaches to learning.

The discussion suggested that there was a need for "Research into how e-learning needs to be specific and contextualised to best meet the wider strategies of the institution". Consequently a role for self-assessment and the self-review of institutional performance was identified, with the caveat that institutions don't choose only those indicators they are comfortable with. This links in with the UK HE Academy approach of developing e-learning benchmarking to inform organisational planning. It was noted that no one yet has effectively linked the implementation of effective e-learning to organisational quality improvement, a possible research issue. It was argued that it is unclear what processes of learning we are in fact actually measuring. The policy issue identified was that we must not be reductive in how learning is characterised however helpful policy makers find simple statements as e-learning is promoting great changes in learning processes. Learner contracts were seen as offering the possibility for a minimum technical specification which would facilitate more effective learning.

Finally a core problem was identified in that both learning and technology are developing somewhat in parallel and not in a connected way, so identifying a minimum specification is not simple as "learning doesn't stop at the institutional level". Integration rather than standards is a key issue as "we don't know what people do to support their learning" in the multiplicity of contexts in which they learn and integration allows learner's to bring their technology styles into the institution.

## *Conclusions on Institutions and Key Performance Indicators*

In light of the points above concerning the change in learning processes and behaviours brought about by e-learning it was recognised that institutional KPI's themselves have major limitations as they are designed to measure traditional learning outcomes through enrolment and destinations.

1. The limitations of KPI's in developing learning were accepted because they capture traditional learning outcomes or current policy imperatives. However the opportunity for self-assessment reviews to make KPI's more relevant to measuring effective learning in "in technology-rich environments" was highlighted.
2. It was also noted that no one has effectively linked implementing e-learning to quality improvement.
3. A key issue related to this concern of the ongoing measurement of effective learning is that both learning and technology are developing dynamically in parallel and in complex ways but are not connected formally. KPI's are not connected to teaching and learning or technology development.
4. The appropriate integration of technology into multiple learning contexts is seen as a key issue in developing the more responsive institution and measures that support this need to be identified.

## *Workshop discussion on Research Evidence*

The prompt for this discussion was the question about whether we should be looking at research about outcomes (that is using evidence about the traditional measures of the effectiveness of learning), or about process (that is using evidence concerning the transformational aspects of e-learning).

The participants at the roundtable arrived at the unanimous view that e-learning was transformational and that if we are to understand its educational effectiveness we need to take long-term views and gather longitudinal data about learning as a process. In the main research is less interested in this approach.

The key point is that learners change their mode of learning in e-learning. They no longer memorise and cram for exams, but they expect to take a "research-based" approach; finding sources, testing for validity and applying the information they find in answering problems that they are trying to solve, and may even set themselves. The communication dimension of learning thus becomes expanded and learners are actively involved in applying their learning practically and demonstrating that they have learnt facts and their relevance. This is where the change in practitioners' roles comes in.

In summary the view on the research evidence was that it had not looked at the transformational nature of e-learning and how it affects the process of learning and had rather looked at mapping it to traditional outcome measures.

## *Research and Policy Agenda Issues*

It was thought that as the nature of e-learning had evolved into "learning in technology-rich environments" this raises a host of policy and research issues. As this work shows definitions, key factors and opportunities are constantly developing and changing the nature of the educational context. The dynamic nature of this change needs to be captured and responded to. The key points to be addressed by research and policy were identified as;

1. It is recognised that the learner changes their mode of learning in different learning contexts, but in what way and how this can be supported is unclear.
2. Research needs to look at the transformational nature of e-learning and how it affects the process of learning rather than mapping it to traditional outcome measures; new measures of effectiveness are needed.
3. Whilst it was argued that preparing practitioners and learners to “design learning” would enable a formalisation of the co-creation of the learning processes how this is to be done precisely is not clear. However identifying the change roles of practitioners and learners is critical and “designing for learning” may be the best way of integrating these developing roles to support a co-creation model.
4. As learning “doesn’t stop at institutional boundaries" a whole set of issues relating to the multiple contexts of learning needs to be addressed
5. Conversations about learning and strategies for supporting learning are complex and they exist in multiple contexts but it was not clear how to use and support these “learning discourses” as a part of learning
6. If we are coming to the end of the phase where we use the term “e-learning”, because all learning takes place in “technology-rich environments”, then to differentiate learning and e-learning is arguably no longer fruitful. How do we measure the effectiveness of this transformation?
7. What then are the definitions and factors relating to the effectiveness of learning in technology-rich environments?
8. It could be argued that the real issue is about achieving effective “quality improvement in “learning in technology-rich environments”? How is this achieved and is this both a Research and Policy issue?
9. In preparing Learners and Practitioners with both the awareness of the need for "designing for learning" and the skills to do so it needs to be recognised that multiple roles exist, on both sides, and these need defining and acting on.
10. Multiple conversations about learning occur in an "underworld" (the “hidden learning environments” of the HE Academy) indicating the need to understand the nature of informal learning processes as they inform formal learning outcomes.
11. In terms of reviewing how to make learning effective in technology-rich environments then the value of using a “course redesign” process over a period of time, perhaps three years, was proposed as a way of identifying the effectiveness of learning “in technology-rich environments” where the co-creation of learning is the driver
12. Research into how e-learning works needs to be specific and contextualised to best meet the wider strategies of the institution. This is arguably about developing institutional e-maturity strategies.
13. Learning, Technology and institutions are all developing in differing ways so “Integration rather than standards” is a key issue as "we don’t know what people do to support their learning outside the institution". How can we best measure this extra-institutional learning?

## *Part 4; Summary of Research and Policy Issues as they relate to relevant stakeholders*

The issues as they stand at the end of this post systematic review discussion process can be summarised as follows:

1. "e-learning" has evolved into “learning in technology-rich environments”
2. Definitions, key factors and learning are all constantly evolving and learning should not be seen as stopping at institutional boundaries; learning occurs in multiple contexts and learning across all relevant contexts needs to be designed for.
3. The learner changes their mode of learning in different learning contexts, but in what way and how this can be supported needs to be investigated
4. Research needs to look at the transformational nature of e-learning and how it affects the process and "discourses of learning";
5. New measures of effectiveness are needed as KPI's tend to map to traditional outcome measures;
6. Identifying the change roles of practitioners and learners is critical and “Designing for Learning" may be the best way of integrating these developing roles to support a co-creation model.
7. Learning, Technology and Institutions are all developing in differing ways so “Integration rather than standards” is a key issue as "we don’t know what people do to support their learning outside the institution". How can we best measure this?

Further resources and participant comments available at;
http://eduserveffectiveelearning.pbwiki.com/

## *Who needs to take account of this research?*

### DCSF

A key finding in this work is how learning occurs in multiple contexts both within the institution and beyond it. Learning needs to be designed for multiple contexts. The multi-stranded nature of the 14-19 Agenda could allow for this characteristic to be actively designed for and the greater involvement of Local Authorities in FE college activities means the locality could be designed in as part of the learning environment. The newly emerging concern with the role of families could be helpful in identifying ways of supporting extra-institutional learning, but most importantly the developing Information Strategy for the Children’s Plan needs to be cognisant of these changes in learning

### DIUS

As the technologies, processes and skills of e-learning develop into the “learning in technology-rich environments” described here then DIUS could review the ways in which post-16 institutions are defined, funded and supported in order to account for this. The HE Academy could be given a greater developmental role in responding to this.

### DCMS

Learning and learning discourse in multiple contexts means a greater use of libraries, museums and archives as both resource centres and learning locations. Library 2.0 explicitly identifies libraries as support centres for this emerging learning and DCMS could ensure that this is both designed for physically and supported practically, perhaps through developed concepts of information literacy, as they develop their policy. Many of the skills demonstrated by learners can be described as Media Literacy and OFCOM could review their approach to media literacy to bring a sharper focus to what it means in terms of learners supporting their learning

## JISC

This work has identified the importance of formative assessment, the co-creation of learning and the need for the skills of "designing learning" in both learners and practitioners. These are all areas where JISC has much experience and expertise and this could be extended to support an understanding of how they can be used to help support learning in technology rich environments.

## EPSRC-TEL

In designing further research calls the Technology-enhanced Learning programme of the EPSRC needs to research the learning discourses around learning in the multiple contexts both within and beyond the institution and the characteristics of effective co-creation of learning using relevant technologies.

## LSC

The LSC is urged to understand the transformational and extra-institutional character of learning in technology-rich environments and to develop measures and provide funding that map to this. This may be best achieved in their New Build work.

## NIACE

The identification of the importance of non-formal modes of education in the learning process, and the importance of informal learning and "learning discourse" all indicate the importance of the extra-institutional dimension of learning. NIACE have done much work on informal and non-formal learning and their expertise in helping understand informal and non-formal learning processes will help in understanding the emerging importance of extra-institutional learning discourses and processes

## QIA

It proved very difficult to define how effective e-learning had been as it was seen as evolving dynamically and should no longer be regarded as a subset of institutional learning. In that we are now learning in technology-rich environments it was seen that quality improvement in learning would be a key factor in determining how effective learning will be. The QIA are urged to develop better measures of institutional effectiveness that will account for this dynamic process of transformational learning

## CEL

KPI's were seen as mapping to traditional learning outcome measures and as not being concerned with reflecting the learning discourses and processes which are being transformed by the developing strategies for learning in technology-rich environments. A greater use of Self-Assessment strategies and Quality Improvement was seen as critical to this development. We urge that CEL develop an understanding of this and transmit it to educational leaders as part of their work.

## LLUK

Learning was seen as being about learning discourse and the role of the practitioner in making learning effective was in their ability to promote the "theorising and socialising" which characterises this discourse and then to make "timely interventions" in order to scaffold effective learning. It is hoped that LLUK will promote an understanding of these changing communication patterns as part of future proofing the lifelong learning workforce.

### UCU

As e-learning develops into learning in technology-rich environments the role of the practitioner changes; they need their traditional subject skills but also need the ability to support learning in an expanding range of contexts. A new set of learning management skills are emerging which need to be deployed dynamically. Unions need to ensure that their member's new skill sets are adequately accounted for in ITT and CPD and are both supported in deployment and rewarded adequately.

### Institute for Learning

It is hoped that the Institute for Learning will have similar concerns for its members in the Learning and Skills Sector

### TDA

It is hoped that the TDA will look at these findings and identify ways to develop Initial Teaching Training to make trainee practitioners aware of the changing discourses around learning and the multiple contexts in which they occur.

### GTC

The General Teaching Council is urged to identify the need to support its members as the changed ways of learning in technology rich environments develop, and that the changes in the skills needed for the co-creation of learning identified here are recognised and supported.

### e-skills UK

E-skills UK have a responsibility for preparing the future IT workforce of the UK and have a keen interest in apprenticeships and Diploma's. As with all post-16 learning this work indicates the need for changes in the way we recognise and use digital skills in learning and e-skills UK are urged to recognise and respond to the changes in the way technologies are used to support learning that this work indicates

### HE Academy,

The HE Academy has done much good work in e-learning benchmarking but is pointed to the findings concerning the transformational nature of e-learning and the recognition that learning takes place in multiple contexts. It needs to identify measures that allow for the necessary changes in HE to be developed and implemented.

### The Innovation Unit

The Innovation Unit may be interested in promoting the innovative character of "learning in technology rich environments" that emerges through this work

### AoC

The AoC is pointed to the findings about the changes in the nature of learning, its extra-institutional character and the need for technology that supports learning to be integrated into institutional systems. This should be of particular interest to AoC-NILTA

**Transformational Government Agenda**

A key theme throughout this work is that learning in technology rich environments as we are beginning to see now transforms education and extends learning into multiple contexts. The Transformational Government agenda needs to be cognisant of and responsive to these findings.

## Digital Strategy

The Digital Strategy is concerned with promoting Broadband Britain and Digital Inclusion. The finding about the extra-institutional nature of e-learning means that Britain needs to have the capacity to support technology supported learning discourses across the nation and in many contexts, libraries and the home as well as within institutions.

## UKERNA

The requirement for a Digitally inclusive strategy to enable technology supported learning in multiple contexts is more properly the direct concern of UKERNA and JANET.

## Becta

Becta needs to ensure that the developing e-strategy allows for more flexible KPI's, for the use of Self-Assessment to help develop e-mature institutions and the opportunity to redesign the educational process to allow for the more dynamic co-creation of learning captured here.

We have been involved in the Autumn 2007 series of Policy Seminars organised by Becta to shape the next version of the Harnessing Technology strategy. We have fed the findings of this review into the discussions that have taken place within this process. At the plenary seminar on November 2 2007 the fact that learners of all ages are enthusiastic about their use of technology for learning was celebrated. The issues highlighted as important for taking the strategy forward within the FE and skills sector included the need for organisational and systematic change and for increased e-capability in the workforce.

## Part 5; Summary of this Post Systematic Review work

The **Roundtable** outcomes focussed on four points from the Systematic Review; firstly the definitions of e-learning which were seen as needing to be extended to account for the changed nature of communications ("theorising and socialising") around learning, secondly the "Five Factors of e-learning" which were seen as needing to be extended to include both motivation (and aspiration) and the requirement for a consistent learning platform, thirdly the "institutional context" in which KPI's were clearly identified as restricting the effective implementation of e-learning because "e-learning changes the combinations of Space, Time and Money necessary for learning to take place" and KPI's measure traditional learning outcomes. Finally the Research Evidence gathered was also reviewed and a concern was identified that research into the effectiveness of e-learning so far has not engaged with its transformational nature and has not been sufficiently longitudinal, so is somewhat limited in its value. This of course in itself is a research issue.

The **Workshop** outcomes took these points forward and extended and deepened them. The big message from this process was that we are at the end of the phase of e-learning and are moving into the phase of "learning in technology rich environments" in post-16 education. Consequently we need to review how we now determine the effectiveness of learning when it is characterised like this. Communications ("learning discourses") were characterised as occurring in multiple contexts with a significant "extra-institutional" dimension. The notion of a consistent learning platform was re-positioned as being about the institutional integration of technology and the digital processes that learners use to support their learning. The issues of KPI's and the transformational nature of e-learning were addressed through two recommendations; Firstly that of developing "designing for learning" techniques which enabled the "co-creation of learning", possibly developed over three year course redesigns carried out with learners. Secondly by revising KPI's and linking them to dynamic institutional self-reviews and quality improvement processes, often called e-maturity.

The key **research** issues that flow from this review are;
Firstly to understand the nature of the "learning discourses" that take place in multiple contexts and then identify how to integrate them into learning. Secondly to identify the multiplicity of technologies being used by learners to support their learning and how they can be integrated institutionally. Thirdly to understand the "transformational" character of learning in technology-rich environments and to identify how co-creation and co-design can provide tools and processes to adapt to this effectively.
The key **policy** issues that emerge from this review are;
Firstly if we are moving from e-learning to learning in technology-rich environments then policy needs to account for the emerging extra-institutional dimension of learning. Secondly that technology policy should not be focussed on providing a pre-defined learning platform but should focus on enabling the integration of technologies that learners prefer to use into appropriate educational contexts. Thirdly policy concerning institutional measures and KPI's should focus more on dynamic institutional models

built on self-assessment and self-review, moderated through inspection, which will enable the adaptation to the transformational nature of "learning in technology rich environments" indicated here.
Finally institutions that need to address the findings here in research terms are probably the JISC and the EPSRC TEL programme.
In policy terms both the new educational departments (DCSF and DIUS) need to develop policy that reflects the extra-institutional nature of learning identified, technology policy needs to be addressed by Becta and JISC and thirdly, OFSTED, QIA and the HE Academy need to identify and implement measures which support a self-review process from which the e-mature institutions necessary to support learning in technology rich environments can develop

# 2. Learning, e-Learning and evaluation

## *2.1 Introduction*

The sectors of Higher Education, Medical Education and Work-Based Learning view the act at the heart of e-Learning, namely *learning*, with different eyes. These differences arise partly out of the differential exposure to learning theory, but also because of differences in perception about what is it is important to understand and evaluate about e-Learning. Bearing in mind this diversity it is useful to make explicit some of the theories and approaches to *learning* that guide and support both the practice and the evaluations of e-Learning in these different sectors.

## *2.2 Levels of Evaluation of e-Learning*

The learner's experience and performance can be categorised according to the level at which the learning has been assessed. In order that this review bears a relationship to other previous reviews Kirkpatrick's four levels of evaluation model is utilised to inform the organisation of the e-Learning literature. Kirkpatrick's (1959) original ideas have been elaborated in his more recent 1998 book 'Evaluating Training Programs: The Four Levels'. This four-level evaluation model is generally considered an industry standard across the Human Resource and training communities. The four levels of Kirkpatrick's evaluation model purport to measure:

1. Reaction of students/trainees - what they thought about e-Learning, their satisfaction with their learning experience (process), and whether they completed their training/course
2. Quality of the learning – is there a learning gain? This could be demonstrated by an increase in knowledge or capability. Additional measures could include comparisons between classroom learning and e-Learning, individual differences in learning, and the effectiveness of the type of course
3. Behaviour or performance – does the e-Learning change the behaviour? What is the extent of the behavioural change in relation to capability improvement and implementation?
4. Results – what are the organisational effects resulting from the learner/trainee's performance? This is generally related to cost savings.

Previous reviewers of work-based e-Learning (Burgess and Russell, 2003; Lain and Aston, 2004) have used Kirkpatrick's four levels of evaluation to organise their reviews of distance learning and learning in the workplace. In medical education Doyle's (2002) review identifies areas where evaluations can take place and systems that can be evaluated. He identifies Kirkpatrick's four levels of evaluation as a model that can be utilised in the evaluations of computer-based simulations in medical education..

The levels of evaluation of learning in organisations increase in complexity, and usually cost, from level one to level four. However Nickols (2005) argues that although the idea of the four levels of evaluation has been acknowledged for the past 40 years the Kirkpatrick model of evaluation is rarely used past the first level which is the trainee or learners' reactions to e-Learning. If this is true then we would expect to

find more evidence about the evidence of the effectiveness of e-Learning under the general heading of 'Learners' reactions to e-Learning'.

Kaufman, Keller & Watkins (1995) also have concerns that the Kirkpatrick four-level evaluation schema is too restricted and does not address important areas for evaluating instructional and other performance improvement initiatives. However they do not reject the framework but suggest an expanded version. This expansion of Kirkpatrick's four-level evaluation would include a fifth level that is concerned with the impact and consequences for society and also a modification of the first level to include consideration and determination of the value and worth of resources and methods (Kaufman & Keller, 1994). We have addressed this issue by incorporating the 'diffusion of innovations' model into our review. The adoption and evaluation of e-Learning by organisations including higher education institutions is relevant at the societal level and dissemination of evidence is essential. For instance, what is the relative advantage of adopting the innovation (e-Learning)? Is the innovation compatible with what is already in existence in the organisation (this includes the cultural norms of the organisation)? Can it be tried out without taking it on in its entirety? Can it be seen to work?

## *2.3 Diffusion of Innovations and e-Learning*

When considering measuring the effectiveness of e-Learning at both the individual and organisational level it is useful to view e-Learning as an innovation. This raises the question of how an innovation spreads. An innovation as defined by Rogers (2003) is 'an idea, practice, or object perceived as new by an individual or other unit of adoption' (p 36). A large number of new ideas are technological innovations. If e-Learning is an innovation, then we need to look at what has been proposed about the diffusion of innovations (Rogers, 2003). The patterns that we observe need to be taken account at the level of an institution e.g. the implementation of an e-Learning strategy in a higher education establishment or the development of an e-Learning programme in industry. However the individual learner also has to be taken into account as the new idea (e-Learning) is adopted by the individual or sometimes shunned or avoided by the 'doubters'.

It is the qualities of an innovation, as perceived by members of a social system or group, which determine the rate of adoption. So innovation is driven both by the nature of the idea or technology and also by the social system in which it is situated i.e. the context. According to Rogers (2003) five characteristics or attributes of innovations are:

1. Relative advantage – whether an idea is perceived as better than one that has gone before it. This can be measured in terms of economics, social prestige, convenience and satisfaction.
2. Compatibility – the measure of consistency with the existing values, norms, past experiences, and needs of potential adopters.
3. Complexity – the level of difficulty in understanding the innovation. New ideas are adopted at a greater speed than ideas that require some effort in acquiring new skills and understanding (e.g. Dvorak keyboard).

4. Trialability – the extent to which an innovation can be experimented with on a limited basis. New ideas that can be tried out in a gradualistic or partial manner are adopted more quickly than those that are not divisible. 'An innovation that is trialable represents less uncertainty to the individual who is considering it for adoption, as it is possible to learn from doing' (p 16).
5. Observability – the visibility of the results of an innovation. If individuals can easily observe the results of an innovation then they are more likely to adopt it.

The attributes of an innovation such as e-Learning can be judged, for instance, based on its relative advantage (is it better than what was available before?), compatibility and its observability (can we see that it is better?). The diffusion of innovations model will have relevance when looking at Kirkpatrick's fourth level of evaluation – the impact of e-Learning on the organisation.

However before looking at e-Learning as an innovation, where the focus is on the role of the mediating technology and infrastructure, it is important to first look at theories of how we learn. What influences the quality of the learning?

## *2.4 Learning theories*

One question that could be asked at the start of a review of e-Learning in the post-16 sector and specifically in higher education, medical education and work-based e-Learning is – Is the learning qualitatively different from that in the school sector? For instance, as post-16 education is not compulsory, motivational factors can play a different part in learning. However despite the differences there will still be generalisations about how we learn. It is therefore useful to revisit theories of learning in instructional contexts.

Laurillard (2002) suggests that a conversational framework model is needed in higher education which entails a discursive, adaptive, interactive, and reflective approach by both the teacher and the learner. This approach is not often considered within the context of work-based e-Learning where the notions of training and instructional design (e.g. Gagné, 1985) are the dominant approaches. Learning theory is sometimes implicit rather than explicit in the literature on the effectiveness of e-Learning in higher education, work-based e-Learning and medical education.

### 2.4.1 Learning theory and work-based e-Learning

As early as 1913 Thorndike (cited in Byrnes, 2001) described a theory of learning where neurally-based associations between situations and responses regulated learning for the student. Teachers primarily used rote repetition and rewards to encourage learning. This theory is related to Gagné's (1962) conditions of learning approach that is the underlying thinking behind instructional design and therefore used extensively within the work-based e-Learning field. Gagné proposed five domains of learning - verbal information, intellectual skills, cognitive strategies, motor skills and attitudes - and suggested that there are different internal and external conditions necessary for

each type of learning. He suggested that there is a nine step process that creates the conditions for learning to take place. These instructional events are matched with the proposed corresponding cognitive processes and are organised in a hierarchy according to their complexity. These include:

- gaining attention (reception)
- informing learners of the objective (expectancy)
- stimulating recall of prior learning (retrieval)
- presenting the stimulus (selective perception)
- providing learning guidance (semantic encoding)
- eliciting performance (responding)
- providing feedback (reinforcement)
- assessing performance (retrieval)
- enhancing retention and transfer (generalisation).

This hierarchy of complexity of learning events and processes include stimulus recognition, response generation, procedure following, use of terminology, discriminations, concept formation, rule application, and problem solving. The main purpose, and reason for the perceived utility, of the conditions of learning approach within the field of work-based learning is in its clarity in terms of the hierarchy. The value of the hierarchy is that it can identify prerequisites that should be completed to facilitate learning at each level. Before moving on to the next level the prerequisites are identified by doing a task analysis of a learning/training task. This sequence of instruction is a design for assessing learning at specific levels. However this does not necessarily mean that this is how learning always takes place. The approach is based on the notion of a traditional or transmission model of learning where the learner is a member of a homogeneous group and where individual differences are only partially taken into account. To some extent the pure transmission model (the "bucket" theory of learning and teaching) is a straw man as even the approach outlined above assumes a fair proportion of cognitive processing and construction on the part of the learner. An alternative approach is to concentrate on individual differences in the approach to learning. In this regard learning styles are a popular tool for some researchers in e-Learning.

### 2.4.2 Learning styles

Learning styles are a popular tool in the field of e-Learning for categorising individuals and then testing what type of learning environment is most conducive for their learning. Many papers on e-Learning, particularly in higher education, include inventories that purport to identify an individual's learning style. So what are learning styles? There is not a clear-cut answer to this question. Put simply - learning styles are different approaches or ways of learning, often contrasting binary approaches. If we take one simple approach then the three types of learning styles could be categorised as: (1) visual learners - those that learn through seeing (e.g. in lectures these learners would prefer to take detailed notes),
(2) auditory learners – those that learn through listening (e.g. these learners often benefit from reading text aloud and using a tape recorder), (3) tactile/kinesthetic learners – those that learn through , moving, doing and touching (these learners prefer a hands-on approach, actively exploring the physical world around them).

Coffield, Moseley, Hall & Ecclestone (2004) did not find learning styles to be as unproblematic as some have suggested. They carried out an evaluation of the concept of learning style and its potential use in post-16 education and training for the Learning and Skills Development Agency and identified 69 theory-based models of learning style which have been productive in terms of research and/or practice. They grouped these into six categories of learning styles which they evaluated paying particular attention 'to previous studies which have looked for improvements in learning when students are made aware of their learning styles or are taught in ways which 'match' their styles' (Coffield et al., 2004). Out of these they selected 13 leading models of learning style (all cited in Coffield et al. 2004) and their associated assessment instruments to evaluate in more detail. These included approaches that stated that learning styles: are largely constitutionally based (Gregorc), reflect cognitive structure (Riding), are part of a stable personality type (Myers-Briggs, Jackson, Apter), are stable learning preferences (Kolb, Honey & Mumford, Allinson & Hayes), learning approaches and strategies are the basis for understanding learning (Entwistle, Vermunt, Sternberg), and learning styles consist of learning and environmental preferences (Dunn & Dunn).

The models proposed by Dunn and Dunn, Herrmann, Honey and Mumford, Kolb and Myers-Briggs are used in business as well as in educational contexts whereas the models developed by Entwistle and Vermunt were developed primarily for use in higher education. Coffield et al. (2004) stated that all the learning styles in the models that they evaluated (apart from one) were assessed using self-report methods. They acknowledge that a seemingly simple task (assessing learning styles) could turn out to be quite complex. One problem that was identified was that '…learning styles models and instruments are being simultaneously developed in the relatively autonomous university departments of business studies, education, law, medicine and psychology'. Inevitably there is no one person or organisation that takes responsibility for these learning models and instruments. In addition, there is a lucrative commercial field advertising materials such as; manuals, videotapes, in-service packages, overhead transparencies, publications and workshops. Coffield et al. are concerned that this is more likely to lead to wider proliferation rather than integration across the many different learning style models. The administration of most of the learning style inventories online leads to them being used indiscriminately and extensively so that a 'trivial hypothesis can be quickly confirmed or refuted. The danger here is of mindless and atheoretical empiricism'. This is something that needs to be taken into account when reviewing the effectiveness of e-Learning particularly in the higher education sector.

### 2.4.3 Learning theories and education

Some psychologists view learning from a constructivist perspective. That is, they view learning as an active process in which learners construct knowledge based on their past experience. For Piaget (e.g. 1962, 1971), knowledge was either (1) a scheme – an action or process that is used repeatedly to attain a goal or solve a problem (2) a

concept – which includes time, space, causality, number, conservation, and classes (classes are categories of things) (3) a structure – something which has both form and content. A knowledge structure is the organisation of ideas. Piaget's constructivist approach entails a child learning about the regularity and structure of the world through experiencing it but that does not mean that concepts are learnt immediately through exposure. Rather it is the child's activities and their mental representations that pave the way for more fully developed ideas. Byrnes (2001) uses a neat analogy to illustrate Piaget's view of knowledge growth where he describes the student's knowledge as a brick wall. The teacher provides the bricks but the students lay (assimilate) the bricks themselves – they construct their own knowledge – and the wall is not always straight. Sometimes the brick cannot be assimilated into the existing wall and the structure has to change (to accommodate the brick). This process of change is referred to as equilibriation and can be viewed as the self-regulation of thinking. This particular approach to learning has been influential in education for many decades.

A similar constructivist approach to learning is schema theory (e.g. Anderson, 1993; Smith, 1989) where knowledge structures can be either objects (e.g. a house) or events ('scripts'). Schemata (plural of schema) are seen as useful as they can categorise experience, enable us to remember and comprehend things, and also facilitate problem solving. Schemata develop through a process of abstraction and can be modified by the student's experience. Teachers need to understand that meaningful learning occurs when students integrate fresh information into an existing schema or when a new schemata is created by acknowledging similarity to existing schemata. This knowledge can be utilised by the teacher when providing an introduction to a new area, by creating links between the new subject and something that the student already knows. In e-Learning the notion is useful in understanding that existing (prior) knowledge is important to students when learning.

Information processing theory (e. g. Newell and Simon, 1972), in parallel with schema theory, also has had an influence on educational researchers. Declarative knowledge (the knowledge that something is a fact) and procedural knowledge (the knowing how to do something) are the two primary types of knowledge structures. Students acquire knowledge through passing information through the sensory store, to the short term memory, and then from there, to the long term memory where it is stored permanently. Learning for information processing theorists is therefore the transformations between declarative and procedural knowledge and their successful transfer from short term to integration in long term memory. Both declarative and procedural knowledge exist in a student's long term memory because the student has used a memory strategy such as rehearsal. Self regulation for information theorists includes both strategies and cognitive monitoring (the decision about what strategy would facilitate a particular goal). Therefore, self regulated students can develop strategies to remember information and how to get things done, and then plan and monitor their performance. Teachers need to acknowledge that there are limitations to how much students can process and remember. There are a number of strategies that teachers can utilise in order to help the student. These include (1) presenting

information in smaller units and giving the student enough time to learn the units or (2) organising single pieces of information into clusters that form 'chunks'. All these strategies would be useful in an e-Learning environment and again relate to prior knowledge and problem solving strategies.

Vygotskian notions of knowledge and learning are used in the e-Learning literature, particularly in higher education, when looking at the effectiveness of collaborative learning environments. For Vygotsky (1962, 1978), knowledge was made up of concepts and functions. Unlike Piaget, he focused on particular concepts known as categories by which he meant a class of things that had a label (e.g. a square). Language, thinking, perception, attention, and memory were termed functions and Vygotsky considered language to be of particular importance. Knowledge acquisition is the process of internalising the language and actions of adults and more able peers. Properly organised learning results in mental development but is not equivalent to development per se. Vygotsky emphasised the importance of the zone of proximal development (ZPD) '...the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.' (Vygotsky, 1978, p 86).

To return to Byrnes's (2001) analogy of the bricks and the wall, where for Piaget the student lays the brick; for Vygotsky, teachers and more able peers sometimes act as 'scaffolds' to enable the student to reach high enough to lay the brick in the wall. Students regulate their learning through three forms of language. These are (1) communicative speech which is communication with others (2) egocentric speech which is speech to oneself (3) inner speech which is the internalized form of egocentric speech. We all use these forms of learning even as adults. However, Vygotsky found that children tend to use egocentric speech in the absence of adults and whilst performing a difficult task. Vygotsky's theory has been applied within educational contexts with the use of 'scaffolding', the acknowledgement that for knowledge to grow materials must be presented that are within the ZPD, and that scientific concepts need to be presented repeatedly in order for students to learn. The key issue in relation to Vygotsky's theory of learning and e-Learning is that collaboration with more capable peers is an important part of the learning process.

Following on from Vygotsky's notion that communicative speech regulated learning, Laurillard (2002) suggested that a conversational framework model was needed in higher education. This entails a discursive, adaptive, interactive, and reflective approach by both the teacher and the learner. At the heart of Laurillard's model of learning is the notion that there needs to be a continuing dialogue between the teacher and the learner 'nurturing the ideas and skills that constitute understanding' (Laurillard, 2002). It necessitates recognition of the difference between interaction at an operational level and interaction at a conceptual level. Educators need to ensure that what happens at both levels is interlinked and that the interactions learners engage in at the operational level do not distract from the desired conceptual interactivity. This is particularly pertinent when we consider e-Learning where the desire to use the

power of technology to engage can lead to gratuitous operational complexity, leaving learners concentrating on the mechanics of the interface rather than the content to be learnt.

Learning theory predominately addresses learning that take places place at the individual level. The assumption is that knowledge can grow and be negotiated over time through the interactions between the learner and the tutor (also between the learners themselves). Learning can also take place at the social level through copying someone more knowledgeable (high in status) or copying the successful behaviours of others (such as using a particular technology when learning). This type of copying can be categorised as role modelling and is referred to in the psychological literature as social learning (e.g. Bandura, 1977) and in the literature on professionalism in medical education (e.g. Hilton & Slotnick, 2005). The interaction between the individual learning and social learning in organisations is of interest. There needs to be some flexibility in the system in order for adaptation, interaction and reflection to take place. Here we are talking about the adaptation of the learner whereas when discussing the diffusion of innovations we are talking about the adaptation of the organisation and the individuals within the organisation. What happens at the organisational level can affect what happens at the individual level and vice versa. This is particularly relevant to the development of e-Learning strategies both within the public (higher education) and private (work-based learning) sector.

# 3. Review Methodology Applied

The findings of the review of the evidence for the effectiveness of e-Learning are presented in terms of what works, how it works and what factors influence how well it works. In conducting this review we have not relied solely identifying on the randomised controlled trial or purely comparative studies as we believe that we needed to include a range of evidence, some of which was more qualitative in nature. As Simons (2003) argues

> … a range of evidence, both qualitative and quantitative need to be considered in a concept of evidence-based practice. Beyond the methodological debate, there are many other factors – social, personal, moral and political – that need to be integrated in coming to a professional judgement about the relevance, appropriateness and use of evidence to inform policy and practice in particular contexts (Simons, 2003 p 305).

## 3.1 Systematic Reviews

Even when it is impractical to adopt the full systematic review approach, elements of the method can be incorporated into the research. Systematic review methodology was originally developed to evaluate the effectiveness of drug trials in health care. This methodology has now been adopted by the education community (e.g. Evidence for Policy and Practice Information and Co-ordinating Centre at Institute of Education, London). More information about the EPPI Centre reviews can be found at http://eppi.ioe.ac.uk/EPPIWeb/home.aspx#EPPI
The elements of a systematic review are:
(1) A set search strategy
(2) Several pre-defined databases that are searched in a systematic manner
(3)The users or people who are interested in the outcomes of the review are consulted at different points in the research
(4) The potential for the review to be replicated by another researcher
(5) Bias is minimised
(6) More than one researcher is involved in the research throughout the project
(7) The conclusions are based on clear and pre-defined outcome measures

A systematic review consists of

- Specifying a review question in consultation with experts in the field. The user perspective is a vital part of a systematic review process, as the users of the research evidence need to be involved in the development of the systematic research synthesis questions.
- Conducting a search of databases, journals (hand searching) and documents etc.
- Focusing on empirical research.
- Consultation with experts in the field in order to make decisions on broadening or narrowing the scope of the search.

## 3.2 Systematic Review Methodology (Some caveats)

There was some discussion with experts at our second expert seminar about our methodology (see http://www.reveel.sussex.ac.uk/ for the full seminar report). We had acknowledged that we were using a *modified* systematic review methodology but the discussions highlighted that other researchers also perceived the difficulty of taking the narrow systematic review methodology in an area such as e-Learning. This substantiates our position and approach to the review of the evidence for the effectiveness of e-Learning.

Greenhalgh, Robert, Macfarlane, Bate et al. (2004) defined a systematic review as 'a review of the literature undertaken according to an explicit, rigorous and reproducible methodology' (p 2). They list the methods as; search of electronic databases, handsearching journals, 'snowball' search techniques (pursuing references of references), and seeking the advice of experts in the field. We very much welcome this definition as it describes our own methodology but does not align our work with a specific EPPI centre approach (see http://eppi.ioe.ac.uk/EPPIWeb/home.aspx). Greenhalgh, Robert, Macfarlane, Bate et al. (2004) also point out that 'The limitations of conventional 'Cochrane style' (similar to EPPI centre) systematic review for the synthesis of complex and heterogeneous evidence are increasingly recognised' (p 3). The field of e-Learning draws researchers from many different disciplines with a multitude of different research methods for evaluating the effectiveness of e-Learning. This heterogeneity needs to be recognized and an appropriate methodology used for the literature review. Oliver and Conole (2004) acknowledge the problem of the scope of any search in e-Learning 'which is intimately related to fields of study such as cognitive science, computer science, management studies and so on' (p 390).

Another method of conducting systematic reviews is that of the 'realist' synthesis (Pawson, Greenhalgh, Harvey & Walshe, 2004). Pawson et al. argue that we need to be clear about the underlying assumptions about how an intervention is supposed to work. They point out that an intervention is never implemented exactly the same way every time because the context, setting, process, stakeholders and outcomes will always be different. This is certainly the case for e-Learning. From the perspective of someone carrying out a realist review the questions are *'what works for whom, in what circumstances, in what respects, and how'* (Pawson et al. p v). They argue that there is a need to produce 'a list of vital ingredients that appear to be needed for an intervention to be successful' (p 3). This is also the path that we have taken in this review. We ask what works but answer the question by producing a list of factors that influence how well e-Learning works.

## 3.3 Our review

A modified systematic review methodology has been used to achieve the aims of the review, which were to:

> Identify and evaluate the evidence for the effectiveness of e-Learning in higher education (specifically undergraduates), in medical education and work-based e-Learning.

The methodology used for this review of the e-Learning literature included:

- A review question was specified in consultation with experts in the field of e-Learning. The user perspective is a vital part of a systematic review process, as the users of the research evidence need to be involved in the development of the systematic research synthesis questions.
- Databases, journals (hand searching), government documents etc. were searched In addition, search engines (e.g. google) were used as the nature of the subject of e-Learning meant that researchers and evaluators conducting evaluations of e-Learning were likely to disseminate their findings on websites (perhaps sometimes instead of an education database).
- The focus was on empirical research on e-Learning in the post-16 sector. However research other than quantitative was reviewed if it was of sufficient calibre.
- In consultation with experts in the field (researchers on e-Learning, e-Learning experts from industry, contributors from Eduserv, DfES, LSDA, JISC, BECTA, HEFCE) decisions were made on the broadening or narrowing the scope of the search. Relevant issues here were how to narrow the focus as we could not cover the whole of the post-16 sector.

## 3.4 The modified systematic review methodology used in this review in more detail

We take into account Simon's (2003) argument that a range of evidence, both quantitative and qualitative, needs to be assessed in order to answer a research question about e-Learning. There are many factors that need to be integrated when making decisions on the relevance and appropriateness of evidence to inform policy and practice in particular contexts.

### 3.4.1 User Involvement

The measures of effectiveness of e-Learning (how we categorise the evidence) have been identified through searches of databases, hand-searching journals, discussion in expert seminars, and feedback from experts on our proposed list of measures.

### 3.4.2 Methods for identifying and describing studies

The first requirement in the search was that the studies must report primary empirical research. For this part of the review, an initial search of databases yielded very few papers that included the search term 'e-Learning' and a more extended search using terms such as 'computer assisted learning' yielded too many papers (2,980 hits on BEI). The search terms needed to be modified and limited dependent on the database.

### 3.4.3 Search strategy for identification of studies

The search for the review of e-Learning in higher education included studies from 1999 to 2005. There was a limited search of the databases: Eric, BEI, and PSYCINFO. Key journals were electronically or hand-searched (where appropriate) across 2004 and 2005 (see appendix 3 for list of journals). In addition, a search on google yielded

references for other reviews. References from the papers identified were also followed up (the snowballing technique). For the review of e-Learning in medical education a similar approach was taken with additional key journals (see appendix 3 for list) and databases e.g. medline being used. For the review of work-based e-Learning more government documents were used in the review (e.g. Becta, UfI) in addition to the papers located through searches of databases and journals.

### 3.4.4 In-depth review and inclusion criteria

An important feature of our review is that we are identifying the gaps in the research on the effectiveness of e-Learning.

- Studies must be experimental
- Study results must include a measure of effectiveness, performance or other educational outcome, including scores on tests and assessments, changes in confidence, motivation, learners' perceptions, tutors' perceptions.

### 3.4.5 Methods of appraising quality and relevance of evidence from studies

The weighting of evidence is based on:

1. Soundness of studies (internal methodological coherence)
2. Appropriateness of the research design and analysis used for answering the review question
3. Relevance of the study topic focus (from the sample, measures, scenario, or other indicator of the focus of the study) to the review question
4. In addition, we included studies with small sample sizes or qualitative/explorative studies that could be used as models for further studies

# 4. How compelling is the evidence for the effectiveness of e-Learning in higher education?

> …Research has the potential to inform related decisions about e-Learning at many levels, though achieving evidence-informed policy and practice requires meaningful dialogue between researchers and policy makers and practitioners. Robust evidence of the impact and added value of e-Learning is at a premium, set within the context of broader educational objectives, like widening participation in learning and raising educational standards. (Pittard, 2004 p 181)

## *4.1 Introduction*

In the first part of this chapter the HEFCE e-Learning strategy is outlined and previous, partial reviews of e-Learning in higher education are examined. In the second part, the evidence on the effectiveness of e-Learning in higher education is presented using Kirkpatrick's (1998) levels of evaluation, as follows:

*(1) What are the learners' reactions to e-Learning? What is the student experience of e-Learning?*

*(2) What is the quality of the learning?*

- Effective e-Learning and learning styles
- Comparing the quality of the learning
- Studies of students' motivation and self-efficacy in e-Learning environments

*(3) Does e-Learning in higher education alter the behaviour of the learner?*

*(4) What is the impact of e-Learning on the organisation*

## *4.2 The development of an e-Learning strategy and previous reviews of e-Learning in higher education*

The Higher Education Funding Council for England (HEFCE) in embedding their e-Learning strategy '…want to ensure that there is confident use of the full range of pedagogic opportunities provided by ICT. For HE this encompasses flexible learning as well as distance learning, and the use of ICT as a communications and delivery tool between individuals and groups, to support students and improve the management of learning' (HEFCE, 2005). They see the HE sector moving towards

- Meeting the greater diversity of student needs
- Increasing flexibility of provision
- Enhancing the capacity for integrating study with work and leisure through work-based and home-based learning
- Developing approaches to individualised support for planning and recording achievements.

In order to do this HEFCE work closely with the Higher Education Academy and the Joint Information Systems Committee (JISC).

HEFCE consider the measures of success and the acceptance of e-Learning to be when:

1. ICT is commonly accepted into all aspects of the student experience of higher education, with innovation for enhancement and flexible learning, connecting areas of HE with other aspects of life and work.
2. Due to more coherence and collaboration, technical issues have been addressed to give better value for money.
3. Students are able to access information, tutor support, expertise and guidance, and communicate with each other effectively wherever they are. They are able to check and record their achievement in a form designed for multiple uses to enable personal and professional development.
4. Tutors have tools for course design to enable better communication between them and their students, giving feedback and targeted support. Individual teachers have access to information about the materials available, and support for continuous improvement of them.
5. Subject communities are able to share materials in ways that enhance their ability to produce customised high quality courses. They are supported to work collaboratively in designing materials, which are effectively quality assured and widely disseminated. They have access to research information to inform curriculum development and research-based teaching.
6. Institutions are able to build appropriate infrastructure and resources support for integrating registration and learning functions. They have links with regional networks of institutions to support progression and community involvement.
7. Lifelong learning networks support connectivity between institutions to provide seamless access for students and staff.
8. Staff are supported at all stages to develop appropriate skills in e-Learning, and these skills are recognised in their roles and responsibilities and in reward structures. They have access to accreditation for their level of skills and professional practice in linking learning technology with teaching.

(HEFCE Strategy for e-Learning, 2005)

### 4.2.1 Systematic Reviews of e-Learning in higher education

Despite a plethora of studies that have looked at specific e-Learning interventions, large-scale reviews of the evidence for the effectiveness of e-Learning in higher education are few and far between. Analysis of the EPPI centre's list of systematic reviews conducted in the post-16 sector up to early 2006 produced one review that has relevance to the research question that this present review addresses. The review (Hassan, Hauger, Nye & Smith, 2005) looked at the use and effectiveness of synchronous audiographic (SAC) conferencing in modern language teaching and learning (online language tuition). In order to be included in Hassan et al's in-depth review, studies not only needed to meet all the criteria for inclusion but also to be primary reports of experimental studies testing the effect of a language learning intervention against another intervention, or standard practice or no intervention. The researchers found 14 descriptive intervention studies conducted since 1990. Four of the studies considered both learners and teachers while another three studies focused

primarily on the teachers but also gave information on the learners. The studies varied in their design from experimental to the more naturalistic and observational. The majority of the studies were in the secondary or post-secondary sectors and were carried out in Australia, the UK, USA, and Canada. Not all these studies would be relevant to this present review of e-Learning in the post-16 sector. Hassan et al's review concluded that although the studies reported positive findings for synchronous audiographic conferencing no study was used in the in-depth review as they did not meet the inclusion criteria. The authors of this review recommended that larger scale, robust studies looking at the effectiveness of SAC in relation to various outcomes were undertaken.

In a meta-analytic review comparing the performance of students in distance education and students in traditional classes, Allen, Mabry, Mattrey, Bourhis et al. (2004) found that distance education students slightly outperformed traditional students on exams and course grades. They argued that their results demonstrated 'no clear decline in educational effectiveness when using distance education technology' (p 402). The overall number in their sample was 71,731 however it should be noted that 63,516 were on a Tanzanian Teacher Training Programme. At first sight there seemed to be no decline in educational effectiveness when using distance education. When the results were examined more closely they showed that for military-related instruction the distance learning environment lowered performance while for the natural sciences and education courses the effect was practically zero. However, Allen et al. did find that foreign language instruction was more effective when technology was used. They also noted that there did not seem to be support for the notion that synchronous interactive technologies increase performance compared to traditional classes.

In a UK review of the literature on implementing e-Learning programmes for higher education, O'Neill, Singh & O'Donoghue, (2004) acknowledged that technology can enhance the learning process but not replace the lecturer or tutor. They list the implications of e-Learning for universities who need quality and flexibility to meet the diversity of students' needs:

- Tailoring courses to suit differing educational needs and aspirations
- Lecturers will be forced to fundamentally change their approach to teaching to accommodate the shift in student learning styles.
- Increased workload requires proactive and effective management. This has implications for the fundamental structure of the university itself.
- Universities must change to accommodate demand and in response to new competition from global, giant corporate and virtual universities. However the problems associated with the change must be fully recognised prior to the transition taking place.
- Many e-Learning implementations in the UK university sector are costly and yet superficial, in terms of learner engagement and activity. They provide a content repository and in many cases limited active learner participation.
- When staff are 'forced' down the e-Learning route as a consequence of management directives and mission statements the creation of sound pedagogic practice is often flawed or missing completely and activities constructed

service the technology rather than student or learner progression or association.

While this review focused largely on the technology and its implementation, O'Neill et al. (2004) argued that the critical factors for success will change with the implementation of e-Learning programmes and asserted that the new key elements in the success of the e-Learning experience are

- Prior experience of using technology
- The technological infrastructure
- The lecturer

On a practical level they suggested that HE institutions can help students to achieve success by providing three elements:

- A face-to-face session familiarising students with the courseware. This will help to overcome the issue of prior experience.
- The functionality of the technological infrastructure should be ensured before the course is implemented. This should be backed up by technical support from either the lecturer or a course facilitator.
- Human resources should be committed to the project at an early stage and lecturers should be selected based on their attitude towards technology, teaching style and ability to control to technology.

Another UK review of the literature looked at the student experience of e-Learning in higher education (Sharpe & Benfield, 2005). This review acknowledged the impact of e-Learning on institutions, practitioners and students and pointed to a gap in the research exploring the experience of the e-Learner. They focused on blended learning (a combination of face-to-face and e-Learning) putting distance learning at one end of the continuum. They looked for literature that illustrated the key features of the student experience and speculated on what had an impact on the student experiences. It was noted that most of the research on student experience of e-Learning focused on very specific and often narrow aspects, for example, asynchronous computer mediated communication. Sharpe and Benfield found that when e-Learning created new or unusual pedagogies the learners reported 'an intensely emotional experience and a major concern with time and time management' (p 6). They argued that e-Learning is often presented as providing flexibility in time and pace of study and that time is a primary concern for students engaging in e-Learning. Their review highlighted some factors:

- Students appreciate having access to course materials and key contacts online
- There is a need to provide induction into e-Learning environments that engage the learners
- Intense emotions are elicited during the learning process ranging from inspiration to frustration
- Students are concerned with time
- Online collaboration or a significant change in the role of the tutor produced the most inconsistencies in student perceptions
- There is a need for tutors to give more explicit explanations of the purposes of online work

**4.2.4 Summary**

There are few systematic reviews of the evidence for the effectiveness of e-Learning in higher education. In a meta-analytic review of distance education it was found that distance students slightly outperformed traditional students on exams and course grades. However there were differences in performance dependent on the type of distance education course. A UK review that focused largely on the technology and its implementation proposed that the key elements in the success of the e-Learning experience were

* Prior experience of using technology
* The technological infrastructure
* The lecturer

Another UK review of the student experience of e-Learning in higher education focused on blended learning and found that key elements that have an impact on the student experience included

* Access to course materials and key contacts online
* Provision of induction into e-Learning environments that engage the learners
* Intense emotions elicited during the learning process ranging from inspiration to frustration
* Students' concern with time
* Online collaboration or a significant change in the role of the tutor produce inconsistencies in student perceptions
* Need for more explicit explanations of the purposes of online work

## *4.3 Are students satisfied with their e-Learning experience?*

Following the Kirkpatrick methodology, we ask what do students think about e-Learning? Are they satisfied with their learning experience? These are measures of the effectiveness of e-Learning and are often assessed by the use of questionnaires and course evaluation forms.

### 4.3.1 Positive attitudes

In a study where preferences were compared using two types of online presentation of course materials, Evans, Gibbons, Shah and Griffin (2004) explored student reactions and performance in different types learning environments. In one study 67 final year students were given the material as web pages and another cohort (n = 48) were given the material as a virtual lecture. Questionnaire analysis demonstrated a preference for a virtual lecture approach. In another study, positive attitudes to a hybrid course format (part online, part face to face) compared to a traditional course were reported by 55 students who thought that the quality of interaction with the tutor was good, that they read text more often, and that they studied in groups more frequently (Riffel and Sibley, 2005). Preferences about the way that learning takes place were expressed in a Japanese study of 333 female students learning English vocabulary via mobile phones. Seventy one per cent of students preferred receiving

their lessons via mobile phones and 93% felt that it was a valuable teaching method (Thornton and Houser, 2005).

Attitudes to e-Learning can be influenced by both personal and situational factors. The role of individual attitudes toward the web as a survey tool based on theories and personal perceptions was explored by Huang and Liaw (2005). They used a survey to assess 279 information management students' attitudes to the web in relation to self-efficacy (a student's judgment of their own capabilities to achieve a specific learning goal), anxiety, usefulness, liking, and the intention to use web surveys. The results indicated that perceived usefulness had a significant impact on intention to use the web. The respondents in this survey with high self efficacy used web surveys. These findings are relevant to issues linked to computer confidence.

Student reactions to e-Learning will inevitably change over time with later cohorts entering higher education with greater computer literacy and confidence in their skills. This was demonstrated by a longitudinal UK study of student experience by Garland and Noyes (2004) which reported that students in later cohorts had more years of computer use and greater confidence. In another study Braak (2004) used a self perceived computer confidence and competence scale and found that there was a significant difference between cohorts across even one year (between 2001 and 2002) on both computer experience and computer use. The later cohort (2002) of students reported more confidence with computers and also more knowledge of distinct computer applications. Both experience and intensity of computer use predicted computer competence. It is also useful to note that the measure is a self-perceived computer competence and that 95% of students in the sample had a computer at home.

Do students value increased access to computers? And does increased access lead to greater academic success? A US qualitative study explored 25 student reactions to a campus-wide laptop initiative at a small liberal arts institution (Demb, Erickson and Hawkins-Wilding, 2004). The value of the laptop to the student was explored through their perceptions of: academic success, study habits, faculty utilisation, development of a learning community, personal use, future plans, and cost. A significant relationship was found between student perception of the effectiveness of faculty members' classroom use of technology and their own perceptions of the value of the laptop to their learning and success.

### 4.3.2 Negative attitudes

Students' negative reactions to some types of e-Learning tools were voiced in a study of 36 students in a project design class in civil engineering which implemented two different technologies: a groupware (shared workspace) and shared wireless laptop computers (Nicol and MacLeod, 2005). It seems that although management group folders (a shared resource) were an effective tool, the students' perceptions of assessment requirements and their negative attitudes to resource sharing limited the use of the folders. Laptops and shared workspace supported quite different types of

collaborative learning. This study also pointed to the individual needs of students in terms of assessment requirements thwarting some collaboration.

### 4.3.3 Mixed attitudes

It is essential to provide students with experiences in online collaboration (Reisslein, Seeling and Reisslein, 2005). However in Reisslein et al's study they found that although the students (33 on-campus students and 4 distance learners split into 8 teams) had very positive attitudes toward the project they were indifferent to the online aspect of the project. Nearly half of the students indicated that what they liked least about the project was that it was all online and over a third indicated that having some project work face to face would improve it. This is an argument for a blended approach to learning that takes into account the students' need for some face to face interaction. How social interaction can be achieved in a virtual environment is one of the foci of social presence research.

Social presence is linked to communication and collaboration and can be defined in a number of ways (1) The ability to define social relationships with reference to the environmental context, divorced from pre-existing relationships (2) The social presence of a virtual tutor mediated by verbal written information, by written information and various personal views, by written and spoken information, by text, by views and spoken language (3) The sense of being together created by the use of telecommunications systems (4) The disappearance of the computer interface in an interaction.

Nowak and Walther (2005) studied the effects of synchrony and the number of cues on the person perception process in computer-mediated communication. 142 students randomly assigned to 39 groups collaborated over a 5 week period to produce oral reports using alternative versions of communication systems or meeting face to face. It had been claimed that the lack of social context cues means that leaner media (e.g. text based systems) induce people to focus more on the task as these systems are not well suited to social interactions. The results of the study showed that those using low cue media felt more certain (more comfortable about their ability to predict other groups members' values, attitudes, feelings and emotions) than those using high cue media. The students also reported that their conversations were more effective but this only happened in low cue groups. These results make a contribution to the discussion of the effectiveness of an online learning environment because they showed that those using low cue media (text only) were more positive about their partners.

**4.3.4 Summary of studies, comparison with previous reviews and recommendations for future work**

Students' satisfaction with their learning can vary dependent on **context** and this includes their **skill level**. In one study students preferred virtual lectures to web pages and positive attitudes were expressed for a **blended learning** format (part online, part face to face) compared to a traditional course. The **quality of the interaction with the tutor** was a factor that influenced student satisfaction. In another study, students' attitudes to the web were influenced by their judgment of their own capabilities to achieve a specific learning goal. Later cohorts entering higher education have more **confidence** in their own abilities and this can influence how they learn. Increased access to computers in a campus-wide initiative showed that student perception of the value of the technology was influenced by the effectiveness of the **use of the technology by faculty**. However other contextual variables can influence perceptions of value. In another study, students' perceptions of **assessment requirements** and their negative attitudes to resource sharing limited the use of a shared resource. It is necessary to provide students with experiences in online collaboration although students can be indifferent to online aspects even if they express positive attitudes to a project. Sometimes it is the type of online media that is used. In a study of interaction in online learning environments it was shown that those using low cue media (text only) were more positive about their conversation partners.

The students' reactions to e-Learning, detailed in this section, concur with previous reviews which have shown that there is a need for the active participation of the learner in e-Learning. Some of the key factors identified in previous reviews that led to the successful engagement of the learner were; prior experience of the technology, the positive attitude of faculty towards the technology, and an acknowledgement that students are concerned about time. Assessment is also a factor that has an impact on students' attitudes to e-Learning. It is still not clear '…what are the most appropriate forms of assessment in an e-Learning world. Research … could provide some interesting evidence' (Pittard, 2004 p 192). The gaps in the literature lead us to recommend that more research is undertaken that includes

* Studies of students' attitudes to different methods of assessment when using e-Learning
* More studies that explore the effect of faculty use of technology on the attitudes of students
* Qualitative studies that look at the student experience in depth

## *4.4 What is the quality of the learning? Are students learning the material?*

In this section we look at Kirkpatrick's (1998) second level and the wide variety of proposed measures of learning and factors affecting how well e-Learning works. Learning/cognitive style is proposed as a factor that influences learner performance.

### 4.4.1 Effective e-Learning and learning styles

Hypertext has been used in a number of studies to explore how students learn effectively. This has relevance to the development of learning skills and also to learning styles. Bromme and Stahl (2005) described how 40 psychology students with no previous experience of hypertext construction were given introductory explanations on the text format 'hypertext' based on either a book (linear) or space (non linear) metaphor. The focus topic was linking nodes about the internet and a 'prior knowledge of the internet' test was given before the task was undertaken. The book metaphor produced a more linear way of viewing hypertexts and this conflicted with the complexity of the content to be processed. The 20 students in the space metaphor group created significantly more links than the 20 students in the book metaphor group. Based on these findings it was claimed that the book (linear) and space (non-linear) metaphors had significantly different effects on the constructed hypertext, the construction process, and knowledge acquisition. The space metaphor is more useful for preparing learners to deal with the complexity of content structures and hypertext structures. However it was acknowledged that performance on a knowledge test showed that metaphorical knowledge does not ensure deeper learning processes i.e. the space (non-linear) metaphor students did not gain more knowledge about semantic relations and more transfer knowledge than the book (linear) metaphor group. Therefore it would seem in this study that the hypertext did not facilitate deep learning processes.

Another study using hypertext questioned the link between an individual's preferred cognitive style (this can be understood as learning style) and the manner in which they access information (Calcaterra, Alessandro & Underwood, 2005). This study looked at the influence of cognitive style (analytical-sequential (linear) vs holistic-intuitive (non-linear)), spatial orientation and computer expertise on hypertext navigation patterns and learning outcomes when 40 undergraduates interacted with a hypermedia presentation. Calcaterra et al. referred to the argument that hypermedia should facilitate learning because of its similarity to human associative memory. This is related to the schemata theory of learning where meaningful learning occurs when students integrate fresh information into an existing schema or when a new schemata is created by acknowledging similarity to existing schemata. However the researchers found that hypermedia navigation was linked to computer skills rather than to cognitive styles and that neither cognitive styles nor abilities affected learning outcomes (as measured by a post test). Higher performance was associated with re-visiting hypermedia sections and visiting overview sections in early stages of hypermedia browsing. This type of behaviour is related to self-explanation and deep learning and is related to a constructivist approach to learning.

So are prior knowledge and also computer skills more important than learning style in computer environments? Mitchell, Chen & Macredie (2005) stated that it is a student's prior knowledge that makes a difference in terms of their learning and argued that hypermedia allows for less knowledgeable students to make greater improvement than knowledgeable students. This means that an understanding of a student's prior

knowledge can increase the effectiveness of the learning environment (hypermedia) and lead to greater learning gains. In Mitchell et al's view hypermedia forces students to make their own decisions on navigation strategies as these systems present course material in a non-linear structure. Two types of prior knowledge were proposed: domain expertise and system expertise. The results showed that out of 74 computer science undergraduate students, those with lower domain knowledge gained more from the hypermedia environment than students with higher prior knowledge i.e. they showed greater improvement in learning performance. The findings also indicated that examples were useful to students with low levels of domain knowledge.

Of course, it does depend on how the cognitive or learning styles are defined. Lee, Cheng, Rai and Depickere (2005) took a different approach to cognitive style by labeling the dimensions as either field dependent (linear) or field independent (non-linear). They then argued that their results indicate that non-linear learning is the primary dimension that determines students' cognitive style. Out of 217 undergraduates on an information technology course, those individuals who preferred a linear learning approach in a hypermedia environment were categorised as field dependent and 'Such individuals generally demonstrate greater social orientation that means that they enjoy working in groups' (p 4). Here the authors are making a number of not necessarily firm links between what they categorised as cognitive/learning style and social orientation. They also argued that based on their findings field dependent (linear) individuals are less capable of controlling their own learning experience. Field independent individuals, however, were more likely to perform better in a hypermedia learning environment as they tended to need less navigational support. The field dependent linear style of learning would seem to be related to the analytical-sequential style of learning mentioned by Calcaterra et al. (2005) and the field independent non-linear style of learning to the holistic-intuitive. However, whereas Lee et al. (2005) found that field independent (non-linear) students were more likely to perform better in a hypermedia environment, Calcaterra et al. (2005) found that it was computer expertise and not cognitive/learning style that affected learning performance. But none of these studies tell us very much about learning at a deeper level.

So does information such as suggested paths through a learning environment facilitate learning? Dunser and Jirasko (2005) examined the effect of structural aid (suggested path through the learning environment) on the learning achievement of 86 students with global (non-linear) and sequential (linear) learning styles, using hypertext. The sequential (linear) learners showed poorer results when learning without the suggested path whilst the global (non-linear) learners achieved the same results in both conditions. Students with global learning styles did not show significantly better learning results when learning with hypertext. Nor did students learning with hypertext with an additional path through the document achieve better learning results when learning with hypertext. However sequential learners learned significantly less when no additional path through the document was provided. It is argued that the findings suggest that hypermedia learning environments with additional navigational aids such as a suggested path should be created in order to help students with different learning preferences.

These different learning preferences or styles would seem to be fixed according to the studies presented so far. In fact, Dunser and Jirasko cite Ramsden (1988) who stated 'Learning styles can be described as the habitual use of a set of similar strategies. Thus they indicate a learner's learning behavior, which is more or less stable'. This would seem to be the general opinion of researchers designing experiments using hypermedia/hypertext. This notion of a fixed and immutable learning style possessed by each learner allows for experiments to be designed on the basis of this being a stable variable. However, the lack of consensus across these studies would seem to have brought the stability (and description) of this variable into question. This is also confirmed by Coffield et al., 2004 who point out that almost all learning styles in the models that they evaluated were assessed using self-report methods. This seemingly simple task (assessing learning styles) is complex as so many learning styles models and instruments are being developed.

### 4.4.2 Comparing the quality of the learning

There are not many direct comparisons between traditional and online learning partly because, as the DfES in the UK argue, 'Traditional teaching methods and e-Learning can and should complement each other' (DfES, 2005). However one proposed method of gauging the learning gain (effectiveness) is through the comparison of online learning with pen and paper, traditional lecture, and face-to-face (F2F) learning. Some studies have compared the proposed learning gains of online learning with those of traditional learning (see e.g. du Boulay, 2000, for a review of evaluations of intelligent learning environments). Morris (2001) described the design and evaluation of a computer assisted learning tool to help 50 psychology students to review their understanding of correlation. It was concluded that both computer assisted and paper-based instructional materials equally contribute to the student's understanding of correlation. However the student's prior knowledge needs to be taken into account in the design of the tool. It was argued that computer assisted learning could provide additional and alternative instruction for students to acquire statistical concepts.

Blended learning (the combination of online and F2F) is an approach to e-Learning that is advocated by many (see DfES above). Riffel and Sibley (2005) reported on a hybrid course format (part online, part F2F) that was developed to deliver a biology course to undergraduates. The hybrid course consisted of bi-weekly online assignments and weekly F2F meetings. The hybrid course (55 students) was taught in parallel with a traditional course (74 students) in which passive lectures covered the same material as the online assignments. Performance on the post course test indicated that the hybrid course was better or equivalent to the traditional course. Online assignments were perceived as equivalent or better than passive lectures and active-Learning was more effective when combined with online activities. It is suggested that online assignments may have improved students' problem solving skills which could have improved the effectiveness of the active learning exercises. This reinforces the argument for a blended approach to learning.

Does the presence of a tutor or instructor in different learning environments have an effect on the quality of the learning? In a qualitative approach to learning Heckman and Annabi (2005) described the similarities and differences in the learning processes that occurred within a face to face (FTF) environment and in an asynchronous learning environment (ALN) with 120 students in four groups. Using discourse analysis they measured the content-relevant communication between learners and instructors. The results were analysed in terms of the discourse process where it was found that the number of utterances in the average FTF were greater than the average in the ALN. The teacher presence was more evident in the FTF compared to ALN. The FTF discussions were more question driven whilst there was more indication of continuing the thread in the ALN. In terms of the teaching process – there were more examples of traditional teaching in the FTF with 125 instances of direct instruction in FTF and only 18 in ALN. Cognitive processes were separated into exploration, analysis and integration. In FTF discussions there were more low level (exploration) categories (70%) compared to ALN (17%). It would seem that the presence of a tutor was more evident and the cognitive processes were more low level in the FTF. This would be an argument for the ALN environment facilitating more analysis and integration through interaction between the students rather than being guided by the tutor.

In addition, are there elements other than the presence (or lack) of a tutor in the virtual environment that can affect learning? Wastlund, Reinikka, Norlander and Archer (2005) examined the effects of video display terminal (VDT ) and paper presentation on performance of a reading comprehension task. They also tested students for both perceptions of workload and stress, using a number of scales. After the test the students completed another stress, tiredness and hunger test (STH) test. In study one (n = 72) the paper condition produced more correct answers on the reading comprehension test. The students in the VDT condition reported significantly higher levels of stress and tiredness. In a second study (n = 72), a verbal creativity test was used. A greater number of alternative answers were produced in the paper than the VDT condition. However there were no significant effects of stress, tiredness or hunger in the second study. These two studies demonstrated that students performed better (achieved more learning gains) with a paper and pencil task and that a comprehension test but not a creativity task caused students to experience more stress online. This is an illustration of how contextual variables (the different levels of stress dependent on task) can affect performance in learning environments.

When comparing different learning environments it is also important to acknowledge that the behaviour of the student can have an effect on whether the learning is successful. Scheines, Leinhardt, Smith & Kwangsu (2005) pointed to an interesting practical issue that can have an effect on learning outcomes and the effectiveness of an online course. They described a series of 5 experiments where over 650 students completed a course on causal and statistical reasoning in either traditional lecture/hour long class or online/hour long class format (blended learning). Online students did as well as the traditionally taught students but the face to face contact during the class (the blended learning element) played a part. For those in the traditional lecture/class condition, attendance in class was 4 times more predictive of exam score than

attendance at lecture. The students in the online environment could work through voluntary comprehension checks but only 50% took advantage of this. Students could print out the modules stripped of the comprehension checks and all interactive material. There was an indication that performance on final exams suffered because of the omission of the interactive aspect of the online course. The results of this study again presented the case for blended learning. Scheines et al. make a valid point in terms of the potential effectiveness of any e-Learning environment - it is important to build online learning environments that support students not only with content and interactivity but also with *advice* as to how best to explout the resources available.

### 4.4.3 Motivation, self-efficacy and assessment

Before looking at the studies of motivation and self-efficacy in e-Learning it is important to state what we mean by these terms. A standard definition of motivation is

> A construct that is used to explain the initiation, direction, intensity, and persistence of an individual's behavior in a particular situation (Stipek, 1993; Wigfield and Eccles, 1992; Eccles, Wigfield and Schiefele, 1998 cited in Byrness, 2001)

The concept of motivation can be discussed under three main headings; (1) goals - what someone wants in the future, (2) knowledge - knowing how to achieve goals using procedures and strategies, and (3) metacognitive processes – which include monitoring progress, use of beliefs to appraise actions, evaluating outcomes, and explaining why outcomes occur (Byrness, 2001). In addition, intrinsic motivation - when people engage in a task as an end in itself, and extrinsic motivation - where people are motivated to engage in a task as a means to an end need to be taken into account.

Dweck (1999) developed a model of achievement motivation and argued that the theories that students develop about their own intelligence guides the goals that they pursue. She suggested that the concept of self-esteem and its role in motivation needs to be rethought. The four common assumptions about successful individuals who love learning, seek challenges, value effort and persist in the face of obstacles, are that (1) students with high ability are more likely to display mastery-oriented qualities (2) success in school fosters mastery-oriented qualities (3) praising students' intelligence encourages mastery-oriented qualities (4) students' confidence in their own intelligence is integral to mastery-oriented qualities. Self-efficacy is a related term which essentially means a students' judgment of their own capabilities to achieve a specific learning goal or outcome.

In a study mentioned in a previous section, Riffley and Sibley (2005) examined the motivation and performance of students (n = 55) in a hybrid course which consisted of online assignments and F2F meetings. They found that significantly more hybrid cohort students than traditional cohort students reported studying or working in groups several times during the semester. They suggested that online assignments may have improved students' problem solving skills which could have improved the

effectiveness of the active learning exercises. In terms of motivation, the hybrid cohort students may have been more focused and motivated to work on active learning exercises when they came to class. Perhaps this is because they had more control over their own learning.

Assessment is another motivator that can drive student learning. In a qualitative study, Macdonald and Twining (2002) looked at student (n = 200) and tutor (n = 12) perspectives on the assessment of an innovative undergraduate course that employed an activity-based approach in a networked environment. They pointed out that assessment plays a major role in driving student learning appropriately. This means that assessment must be intimately linked to effectiveness and motivation. Their study explored (1) the extent to which assessment supports student learning and participation (2) the factors influencing the effective design of assessment for activity-based learning in networked environments. The issue of participation (which can be seen as a measure of effectiveness) is crucial for an activity-based course. Macdonald and Twining argued that when the activities involve online communication the issue of participation is even more important as non-participation by one student can have an impact on other students on the course.

In terms of participation in online conferencing and internet searching with fellow students it was found that success was related to a variety of factors, most notably the skill and moderation style of the tutor. However the greatest barrier to successful participation was the lack of integration of assessment with the collaborative task. Macdonald and Twining pointed out that the effects of assessment on student learning are common knowledge within conventional university courses. They explained the lack use of a learning portfolio during the course in terms the importance of integrating learning activities closely with assessment and also making clear the penalties for not fulfilling the assessment criteria.

The three key issues for the assessment of activity-based learning, according to Macdonald and Twining, are that (1) Assessment must reflect course philosophy. For example, if the course is activity based, the assessment must reflect the type, or types of activities in which students are expected to engage. (2) Assessment is essential in creating learning opportunities at critical points. In order to ensure the student's participation there needs to be a close integration of learning activities with assessment. (3) Assessment provides an opportunity for feedback. Assessment can provide a vehicle through which online distance students receive feedback. Macdonald and Twining pointed out that assessment plays a major role in driving student learning appropriately. This means that assessment must be intimately linked to effectiveness and motivation.

But does intrinsic motivation, where students engage in a task as an end in itself, always lead to better performance? Martens, Gulikers and Bastiaens (2004) state that students with high intrinsic motivation, where the activity is performed for the inherent satisfaction of the activity itself, often perform better than students with low intrinsic motivation. They investigated the behaviour of students in an electronic

learning environment (ALP) that was designed as a game-like realistic simulation in which students played the role of a junior consultant. The results showed that although there was no significant relationship between intrinsic motivation and the number of pages visited in the learning environment, intrinsically motivated participants were more explorative. However performance measures (multiple choice test and content statements) showed that intrinsically motivated students did not acquire more knowledge of the content.

Learner control seems to be a factor in Marten et al.'s findings and certainly individual differences in students' learning preferences in online learning environments play a part. Lee et al. (2005) point out that students' preferences within learning dimensions such as linear/non-linear, level of learner control and multiple tool usage need to be taken into account as a means of motivating the student's acquisition of subject matter through individualised instruction. This is supporting the argument that there are individual differences in approaches and performance within hypermedia. But the context, which includes the learning environment itself, is also important.

Do authentic online learning environments, which reflect the way knowledge and skills will be used in real life, result in higher performance and an improvement in intrinsic motivation of students? Gulikers, Bastiaens and Martens (2005) reported the effects of an authentic learning environment on student performance and experiences (n = 34). It was shown that the students in the authentic learning environment did not perform better than the students in the less authentic environment and that students in the non authentic learning environment used more content statements and more words in their report. The reported experience of learning also did not differ between the two groups. It is suggested that the non-authentic condition might have been less distracting – it did not contain as many multimedia features – though this opens questions about the meanings of "authentic" and "non-athemtic". This leads to the conclusion that the multimedia environment did not motivate students more than the non authentic learning environment. Gulikers et al. seriously question the effectiveness and efficiency of many of the multimedia features and add-ons that are all too often in 'modern' electronic learning environments.

However, the environment and its design are considered to be important in motivating students (McAlister, Ravenscroft and Scanlon, 2004). McAlister et al. suggested that educational dialogue can be used to support learners in the development of critical thinking, reasoning and argumentation in a synchronous online peer discussion. The tool can guide students' dialogue in ways that improve argumentation and collaborative knowledge development i.e. it provides sentence openers organized by intention 'I think' 'I disagree because'. They claimed that students (n = 22) engaged more with each others' positions and produce deeper and more extended argumentation when using the tool. The claims are tempered by the statement that these are preliminary findings and that the improved dialectic was not necessarily significant.

One indicator of motivation is when students choose, voluntarily, to engage in learning outside the compulsory requirements of a course. Grabe (2005) looked at the voluntary use of online lecture notes to explore issues of student effectiveness and motivation (n = 183). Notes can be provided on the web but tutors are reluctant to provide them as they worry that this will lead to non-attendance at lectures. Grabe used log files and questionnaires to examine the voluntary use of online lecture notes, look at patterns of note use and the use of notes as an alternative to class attendance. The conscientious use of online notes was associated with higher examination scores. However there were no difference in examination scores between those note users who skipped class and those who did not.

If students are given a choice in the way that they can navigate learning environments does this motivate them to learn? Dunser and Jirasko (2005) suggested that hypermedia learning environments with additional navigational aids should be created in order to help students with different learning preferences. They further claimed that the opportunity to choose the learning environment can also improve student's motivation for and interest in learning. Perhaps confidence in the learning environment is also a factor when considering choice? Garland and Noyes (2004) in one of the few longitudinal studies in this review, reported two studies with 235 undergraduates looking at undergraduate use, confidence toward and expectations of learning from computers. They found that students in later cohorts reported more years of computer use and greater confidence. They further demonstrated that higher levels of computer use and confidence were associated with higher levels of learning as measured by correct scores on the recall test. They argued that it would seem that the learning expectations from computers are improving and are now at similar levels to print media. 'Multimedia presentations may be differentially beneficial to less literate people, even in a group with low overall formal education' (p 268).

**4.4.4 Summary of studies, comparison with previous reviews and recommendations for future work**

There is no consensus between the studies that look at learning styles and the hypertext environment on what factors influence how well e-Learning works. This is because many different variables need to be taken into account, though **context** is a powerful influence on the application of skills and on knowledge gain.

The straightforward comparison between traditional and online learning is not reported extensively but it has been found, for instance, that both a computer assisted learning tool and traditional paper–based materials can contribute to a student's understanding of correlation. Online students often do as well as the traditionally taught students but again **context** can play a part.

There are many studies that compare a **blended approach** (a mixture of online and face-to-face) to traditional face-to-face (FTF) approaches, but their results are conflicting and often depend on the type of task and environment in use,

**Assessment** is a powerful driver of student learning in higher education and can contribute to motivation in learning. To ensure participation there needs to be a close integration of learning activities with assessment in a networked learning environment.

Some of the factors affecting the quality of the learning of students, detailed in this section, concur with previous reviews. For instance, previous reviews indicated that high ability students could benefit from an individualised expert teaching system, computer expertise of the students contributed to the success of an e-Learning experience, and tutors' attitudes towards technology, their teaching style, and their ability to control the technology influenced students' performance in an e-Learning environment. This relates to the findings in this review that teacher presence (virtual as well as physical) and the students' understanding of the potential of the learning environment are both factors that can have an impact on the success of e-Learning. So it is the human factor that makes a difference to learning in virtual environments.

The gaps in the literature lead us to recommend that more research is undertaken that includes

* Studies that look at the impact of the integration of learning activities with assessment in a networked learning environment
* Studies that look at different types of assessment and their effect on the motivation of students

## *4.5 Does e-Learning change the behaviour of the students?*

In this section the evidence for proposed changes in the behaviour or performance of the learner due to e-Learning is examined? Monitoring interaction with and through technology is one way of assessing any change in the behaviour of the learner. The importance of assessing learners' skills is linked to the engagement of the workforce.

Engaging learners through interaction with the medium can support deep learning and familiarity with the internet will enable those users to exploit interactive features (Ford & Murphy, 2002).

### 4.5.1 Interaction and Collaboration

One type of collaboration is learning through the sharing and exchanging of information among a peer group and this can be mediated through computers. Measures of this type of collaboration would be the manner in which the tools are used, the relative contributions of the collaborators, and the logs of the interactions. One study that gave an interesting insight into how tools are used collaboratively for individual ends was Wilson's (2004) investigation of how the use of an asynchronous learning environment can affect students' attitude and performance. The asynchronous learning environment was meant to augment a traditional lecture/lab course by allowing 86 students to devise, critique and revise questions which then contributed to end of course exams. The posted questions in the learning environment could be challenged but prior to being challenged questions could be deleted by team members. High grades were achieved by students who made numerous challenges (this was assessed by the logs) and who accessed the exam question database frequently. This is in contrast to the claim that it was collaborative learning as such. Wilson pointed out that 'High levels of participation were gained in the present study simply by setting up structural incentives and social pressures, e.g. automated public notices of laggardly performance. Students realised quickly that posting their questions ahead of schedule gave them a wider range of material to choose from, and once they accessed ExamNet [the learning environment] to earn participation credits many students found it interesting and game-like to review their peers' questions and consequently become internally motivated to continue' (p 101). This illustrates the point that although this paper purports to be about collaborative learning it has more to say about individual motivation and changes in behaviour in response to the learning environment.

In another study which looked at resource sharing and collaboration in a project design class in civil engineering (n = 36), two different technologies: a groupware (a shared workspace) and shared wireless laptop computers were implemented (Nicol and MacLeod, 2005). The focus of the study was on way the two technologies supported resource sharing within and across project groups and the forms of group collaboration that resulted. There was a difference in the way that the two technologies were used. The shared workspace was used as a location-independent central repository of resources and group activities were coordinated around it. The laptops were used as a focal point for F2F discussion of these resources. This means that different types of learner collaboration could be afforded by the different technologies. Management group folders (a shared resource) were an effective tool but the students' perceptions of assessment requirements and their negative attitudes to resource sharing limited the use of the folders. Laptops and shared workspace supported quite different types of collaborative learning. This study also points to the individual needs of students in terms of assessment requirements thwarting some collaboration. In this sense this paper also addresses issues of motivation.

Another type of collaboration would be a discursive process where the measure of its effectiveness would be gauged through the analysis of the discourse. Heckman and Annabi (2005) used discourse analysis to measure the content-relevant communication between 120 learners (in four groups) and instructors. Their study has been described in the section on learning where they look at the similarities and differences in the learning processes that occur within FTF environment and in an asynchronous learning environment (ALN). They proposed that responses from learners to learners differ from those responses from learners to instructors. The results indicated that teacher presence was more evident in the FTF (average141 utterances) compared to ALN (average 11). The FTF discussions were more question-driven whilst there was more indication of continuing the thread in the ALN. Students played a greater role in creating a social environment in ALN. This paper addressed questions about the type of interactions and learning that took place in the two environments and pointed to a difference in behaviour dependent upon whether the interaction is FTF or asynchronous.

In a recent approach to the facilitation of collaborative learning at the process level, learners were provided with cooperation scripts that specified and sequenced their collaborative learning activities (Makitalo, Weinberger, Paivi, Jarvela & Fischer, 2005). This study investigated the effects of an epistemic cooperation script (which gave guidance in the form of prompts) on the amount of discourse, information seeking and individual learning outcomes in collaborative learning in an online learning environment (a website where three learners can post messages). The results showed that the amount of discourse was higher in the epistemic script condition. It was reported that learners sought information less often in the epistemic condition but this was not significant. Individual learning outcomes were higher in the unscripted (uncertain) condition. It was argued that learning environments should provide a degree of uncertainty. Uncertainty reduction theory proposes that as the amount of verbal communication in initial interaction situations increases, the level of uncertainty decreases. It was claimed that in this study it was the unscripted uncertainty condition that improved learning outcomes. Participants in the unscripted group sought information more directly by clearly indicating their lack of understanding. The unscripted (uncertain) environment elicited the type of behaviour (communicating a lack of understanding) that led to improved learning outcomes.

Does communication in electronic discussion groups have an impact on cognitive processing? Schellens and Valcke (2005) asked whether collaborative learning in discussion groups could result in enhanced academic discourse and knowledge construction. They predicted that (1) that proportion of task oriented communication would be greater than the proportion of non-task-oriented communication (2) the more discussion activities in groups, the more phases of higher knowledge construction would appear. Of the 1428 messages analysed, 1095 were task oriented. Communication in the groups did not become more task oriented over time and more communication reflecting higher phases (for instance, co-construction) of knowledge construction was not observed at the end of the research period. However more discussion activity in the groups did mean that more phases of higher knowledge

construction appeared. By higher knowledge they mean the knowledge as categorised by the 5 phase model of; sharing/comparing, dissonance/inconsistency, negotiating/co-construction, testing tentative constructions, statement/application of new knowledge. This was a study of collaborative learning based on a proportion of data taken from a massive data set using 23 groups of 10 students over 4 months. This study highlighted the fact that immense amounts of data can be available from virtual interactions.

Collaboration in most studies is seen as a 'good' outcome or process even if the motives of the students are more individual and competitive than collaborative. Reisslein, Seeling and Reisslein (2005) argued that it is essential to provide students with experiences in online collaboration. The study focused on an online team design project in which students (33 on-campus students and 4 distance learners split into 8 teams) collaborated via a team website on a design project related to an emerging communications network topic. It was found from analysis of online interactions on the team websites that online team communication was to a large extent concentrated on managing the team and the project. Both the students with higher prior knowledge and lower prior knowledge achieved approximately the same learning gain. However the students were indifferent to the online aspect of the project. Nearly half of the students indicated that what they liked least about the project was that it was all online and over a third indicated that having some project work face to face would have improved the experience.

Another study of behaviour and technology was a campus-wide laptop initiative studied by Demb, Erickson and Hawkins-Wilding (2004). They found that laptops impacted on the study habits of 73 students in that they were used for convenience, typing and research. However there was little mention of interaction online. For two thirds of students the laptops made a difference to their study habits, academic and social lives. It is important to note that student perception of the value of the laptop to their academic success was tightly correlated with their perception of the success of faculty in integrating the laptop into teaching and classroom activity. There was a negative response to the creation of online communities with 62% not using chat rooms. It would seem that behaviour can change with the introduction of technology (e.g. laptops) but other behavioural variables, such as the success of the tutors in integrating the technology into the classroom and teaching, has an impact.

Another study of online communities also pointed to the behaviour of the students being influenced by contextual variables (Erlich, Erlich-Philip and Gal-Ezer, 2005). The study with 153 computer mediated communication (CMC) course students demonstrated that the use of CMC was minimal and that the use of the technologies depended on the levels of expertise of the individuals using them. Erlich et al. came to this conclusion after examining whether taking a computer literacy and applications (CLA) course before a CMC course had an impact on students' participation in the CMC course and on the effective use of the tools. The implication from this study is that prior computer literacy can influence the level of usage of a computer mediated communication environment. Perhaps this is because the level of computer skills of an individual could be gauged by their fellow students if they were interacting in a shared

environment? This could lead to decreased motivation, fear of failure (to communicate), low self esteem, and anxiety. A shared environment could be perceived as more threatening to the less computer literate.

**4.5.2 Summary of studies, comparisons with previous reviews and recommendations for future work**

Collaboration is seen as the sharing and exchanging information and high levels of participation can be gained by setting up structural incentives and social pressures. Different environments encourage different types of **collaborative behaviour**. A shared workspace can be used as a location-independent central repository of resources whereas laptops can be used as a focal point for face to face discussion of these resources. Discourse analysis has shown that students can play a greater role in creating a **social environment** in an asynchronous learning environment rather than in a face to face interaction. A degree of **uncertainty** facilitates learning in an environment where students needed to ask more questions improved learning outcomes. However it has also been shown that more discussion activity in groups does not always lead to increase in knowledge. Communication in groups is sometimes about management of the teams rather than about the learning itself and the provision of computers does not always lead to collaboration but rather more individual activities. In online communities students can also be influenced by contextual variables such as **levels of expertise** of the individuals using them.

Previous reviews have shown that there is very little evidence available on the effect of e-Learning on the behaviour of undergraduate students. The gaps in the literature lead us to recommend that more research is undertaken that includes

* More exploration of students and tutors' use of handheld devices.
* Observational studies of student behaviour in coordination with self-report methods.
* Studies looking at the impact of a shared learning environment on the less computer literate.
* Studies that look at the impact of online learning on attendance at parallel face to face sessions.

If we move away from an approach that attempts to categorise the student (learning styles) and towards an exploration of the e-Learning environment (which includes other students) then an understanding of when collaboration works and when it breaks down is essential if students are going to communicate effectively with each other and with their tutor.

## *4.6 What are the organisational effects resulting from the learner's performance?*

In this review of the evidence of the effectiveness of e-Learning in higher education there was very little research that looked at the organisational effects resulting from e-

Learning. Twigg (2003), in an extensive USA study made strong claims about the improvement of quality and the reduction of costs linked to e-Learning. The study monitored the progress of a programme whose purpose was to encourage colleges to 'redesign their instructional approaches using technology to achieve cost savings as well as quality enhancements' (p 1). The first round of projects involved ten institutions over two years from 1999 to 2001. It was set up as the pilot project for the overall program and redesigned courses included sociology, statistics, mathematics, computer literacy, American government, astronomy, psychology, chemistry and algebra. Five of the ten projects reported improved learning outcomes, four reported significant difference and one was inconclusive. Most of the learning outcomes were based on tests/grades. Seven of the ten projects showed improvement in course completion/retention rate. All ten projects made significant shifts to a more active learner-centred enterprise. The most effective quality improvement techniques as reported by the ten projects included: continuous assessment and feedback, increased interaction among students, online tutorials, and undergraduate learning assistants (ULAs).

In terms of cost reduction strategies and successes, Twigg reported that the approach most favoured (7 out of 10 of the projects) was to keep student enrollments the same while reducing instructional resources. Seven of the ten projects showed a decrease in drop/failure/withdrawal (DFW) rates. The most effective cost savings techniques, taking into account that the single most costly item was personnel, were reducing faculty time and transferring some tasks to technology assisted activities. The main techniques used by the projects included: online course management systems, online automated assessment of exercises, online tutorials, shared resources, staffing substitutions, and reduction of space requirements. This program encouraged colleges to redesign their instructional approaches in order to use technology to achieve cost savings as well as quality enhancements. The learning outcomes however were less clearly defined. The courses were diverse (e.g. sociology, algebra) and there was no insight into any differences between the courses in terms of measurement of learning outcomes and students response to the learning.

# 5. How compelling is the evidence for the effectiveness of e-Learning in medical education?

> Whether or not internet based, online, or electronic learning is less effective; is as effective; or is more effective than conventional educational methods, the industry is moving educational institutions into an electronic educational format. Educators must thus attempt to determine where this visually entertaining form of communication is most cost effective in the education process (Malloy, 2002 p 5).

> It is becoming "a truth universally acknowledged" that the education of undergraduate medical students will be enhanced through the use of computer assisted learning. Access to the wide range of online options …must surely make learning more exciting, effective, and likely to be retained. This assumption is potentially but by no means inevitably correct. (Greenhalgh, 2001 p 1).

## *5.1 Introduction*

Medical education is in a state of flux, not just because of its increasing use of e-Learning, but also because of the changes in the organization, delivery and ethos of medical education itself, e.g. toward a more whole-person/patient-centred view .

The first part of this chapter examines previous, partial reviews of e-Learning and medical education. Many such refer to CAL rather than e-Learning, but are treating CAL as a sub-category of e-Learning. In the second part, the evidence on the effectiveness of e-Learning in medical education is presented using Kirkpatrick's levels of evaluation.

## *5.2 Previous reviews of e-Learning in medical education*

Reviews of e-Learning in medical education tend to focus on a specific aspect of e-Learning rather than giving a general overview. Examples of these include reviews of computer assisted learning in undergraduate medical education (Greenhalgh, 2001) computer-based simulations (Doyle, 2002), computer-aided instructional programs in dental education (Rosenberg, Grad & Matear, 2003), web-based medical education (Eynon, 2004), web-based continuing medical education (Curran & Fleet, 2005), general practitioner's use of e-Learning (Sandars & Walsh, 2004), e-Learning practices for undergraduate medical education (Lau & Bates, 2004), barriers to e-Learning for health professionals and students (Childs, Blenkinsopp, Hall & Walton, 2005), and mobile technologies in the health context (Walton, Childs & Blenkinsopp, 2005).

Greenhalgh (2001) produced a systematic review of computer assisted learning (CAL) in undergraduate medical education. In this review she listed the decisions to introduce CAL into the undergraduate curriculum, which include; (1) it is convenient and flexible with possibly fewer face-to-face lectures and seminars therefore placing fewer geographical constraints on staff and students (2) it is suited to subjects that are visually intensive (3) the possibility for personalised learning where learners can progress at their own pace (4) once an application is set up the cost of offering it to more students is relatively small (5) a medical school using e-Learning extensively might have a competitive advantage (6) the ultimate goal of higher education is achieved – linking people in learning communities (7) the virtual campus can potentially alter the relation between people and knowledge. She points out that

- Reduced funding, rising student numbers, geographical dispersal, and increased competition in a complex global market have put medical schools under pressure to embrace computer assisted learning.
- New technologies may have important educational advantages, but without support and training for staff and students they could prove an expensive disaster.
- Expansion of computer assisted learning requires cultural change as well as careful strategic planning, resource sharing, staff incentives, active promotion of multidisciplinary working, and effective quality control (Greenhalgh, 2001 p 40).

Greenhalgh's review of articles on CAL in medical education identified 200 potentially relevant studies that reported on comparative studies where the same topics had been taught using traditional and computer-based methods.. Only 12 of these were 'prospective randomised studies with objective, predefined outcome criteria' (p 41). The 12 studies were diverse and were therefore not directly comparable. But a general overview of the studies provided indications that about half showed significant differences between conditions (n.b. some studies were not direct comparisons of online and traditional learning). Interestingly, Greenhalgh states that most studies had methodological problems which included lack of statistical power, potential contamination of data between intervention and control groups, and sample size decreasing whilst the study was in progress. She concluded from a review of the studies that CAL can work in medical education *but effectiveness was still an open question*. This is quite a critical review that looked closely at the papers identified.

In another review of CAL, specifically of programs in dental education, Rosenberg, Grad & Matear (2003) suggested that computer-aided learning (CAL), self-instructional programs provide an accessible, interactive, and flexible way of presenting curriculum material. They reviewed articles that included 'randomised controlled trials comparing CAL with any other method of instruction, and the use of academically homogeneous dental students or dental professionals with objective, predefined outcome criteria measuring performance, time spent, and attitudes' (Rosenberg et al. 2003 p 524). They found 1,042 articles, of which 12 were included in the final review. The findings included:

- 5 studies reported statistically significant differences in outcome measures (scores on multiple choice, written or oral tests, and clinical performance) favoring CAL over comparison group(s),
- 6 studies reported no statistically significant differences.
- One study reported a greater improvement in test scores in the seminar group over the CAL group.

They concluded from their review that CAL was *as effective as other methods of teaching and can be used as an adjunct to traditional education or as a means of self-instruction*.

A review of the literature on the usage, lessons, and limitations of e-Learning for undergraduate medical education with an emphasis on synchronous delivery in the first 2 years was conducted by Lau & Bates (2004). The studies reviewed covered the years 1997 to 2002. Out of the 50 papers included in the review there were 7 video-conferencing articles and 6 review articles on e-Learning in undergraduate medical education in United States and Europe. They found that there were few studies that addressed distributed synchronous learning in undergraduate programs in medical education. The evaluation measures used in the studies that they reviewed included; user satisfaction, actual usage, subjective feedback and student performance. They stated that *overall the evaluations were generally favourable* but there was a problem with comparing the studies as they used different technologies, content and sample populations. Greenhalgh (2001) also found that the 12 studies that she identified were too diverse to be directly comparable. Out of the 50 papers that Lau and Bates reviewed they found one longitudinal study (Broudo, 1999) that looked at computer needs and assessment.

Eynon (2004), in a systematic review of web-based education concluded that none of the studies that she identified were of a high enough quality to include in a systematic review. She stated that '*at present there is no evidence to evaluate the effectiveness of web based education as compared to other modes of delivery* for the education of undergraduates involved in clinical practice' (p 1, our emphasis). However the evidence available to determine what the effectiveness of web based teaching might be, relative to traditional methods of delivery, was reviewed with the focus on undergraduate students who were involved in any aspect of clinical practice.

Eynon's review was fairly narrow as the search strategy produced 383 papers of which 6 were identified as relevant. None of the six papers reported on research in the UK. Two studies replaced traditional teaching formats with one that used the world-wide-web for teaching. The other four added web based components to an existing course but the method used varied considerably across the courses. The quality and validity of each study was assessed and were found to be not of high enough quality to include in a systematic review.

Not all reviewers use a systematic review methodology. In another review of web-based learning, Curran and Fleet (2005) looked at web-based continuing medical education and found that the majority of evaluative research on web-based continuing

medical education looked at the reactions of the learner and participant satisfaction. They found that there was limited research demonstrating any change in behaviour linked to e-Learning and recommend evaluative research on web-based CME '…to examine in greater detail the *nature and characteristics of those web-based learning technologies, environments and systems which are most effective* in enhancing practice change and ultimately impacting patient and health outcomes' (p 561, our emphasis).

According to Sandars and Walsh (2004) there has been increasing interest in e-Learning for general practitioners (GPs) in the UK. They suggested that it is important that future developments and policy decisions regarding GPs and e-Learning are evidence-based. They reviewed the literature of the past five years (1998 – 2003) in which e-Learning had been used by GPs for continuing professional development, and also for training future GPs. They identified 352 articles and out of these 29 were relevant to the review. The majority of the studies identified were carried out in the USA and Canada with only two studies that had been performed in the UK. There were only two studies that resulted in changes in clinical or professional behaviour. Furthermore there were no studies that compared different methods of e-Learning. They found no reviews that evaluated the use of PDAs and no systematic reviews in the area.

Sandars and Walsh found that GPs, especially rural GPs, were positive about e-Learning, and specifically the sharing of experiences with other colleagues and the opportunity to work at their own pace. However these findings were predominantly from USA, Canada and Australia where there are 'major difficulties in providing outreach learning opportunities to isolated GPs' (p 311). They suggested that this might not apply so much to UK GPs who are less geographically isolated. Barriers to the implementation of e-Learning included technological problems with many learners stating that they had low competence and confidence in the use of information technology. Sandars and Walsh pointed to the socio-technical issues that need to be overcome if the potential of e-Learning is to be realized by GPs in the UK. They also argued that *an evidence base needs to be developed.*

In a UK study, Childs, Blenkinsopp, Hall & Walton (2005) carried out a review to identify the barriers to e-Learning for health professionals and students. The project also established possible ways to overcome these barriers. They identified 57 papers that were relevant to this review. They also supplemented the review with a questionnaire survey of learners and an interview study of learning providers. The main barriers to e-Learning for health professionals were:

- requirement for change
- cost
- poorly designed packages
- inadequate technology
- lack of skills
- need for a component of face-to-face teaching
- time intensive nature of e-Learning
- computer anxiety

The literature on mobile technologies in the health context was reviewed by Walton, Childs & Blenkinsopp (2005). They found that most mobile technology applications were occurring in the USA. At the time of the review, in 2004, 'the most prevalent mobile technologies were PDAs, laptops, WAP phones and portable radios with use being concentrated around doctors in the acute sector' (p 51). They also identified a range of advantages and disadvantages to the technology. In their review they found that mobile technologies were mainly being used for clinical rather than learning applications and that students showed a low level of awareness of the technology but placed great importance to accessing learning resources from the community. They point out that there are many developments and changes in mobile technologies and that since their review, podcasting and videocasting is now being used by health professionals. However mobile technologies are not yet used widely enough to enable, for instance, nursing students to remotely access learning resources. The reasons for this are:

- low level of student awareness,
- limited relevance of software and limitations in the hardware

However it is acknowledged that the technology has potential to meet the needs of these students and a greater understanding is needed of how and when these students access learning.

Doyle (2002) reviewed the application of computer-based simulation to medical education and focused specifically on anesthesiology and critical care medicine. This area includes physiological and pharmacological simulation, virtual experiments, software only clinical simulators, and specialised hardware/software simulators for speciality teaching, as in airway management and in regional anesthesia. It is stated that computer-based simulators used in medical education fall into four categories (1) screen-based text simulators which create verbal scenarios from which the user chose one of several responses (2) screen-based graphical simulators that aim to recreate elements of reality in graphic form on a computer screen (3) mannequin-based simulators are available in various levels of complexity including a physical model of the human body (4) virtual reality trainers offer a transition from the 2 dimensional world of the textbook to the 3 dimensional world of the simulated patients. He found a wide variety of applications and a promising outlook.

### 5.2.1 Summary of other reviews

Systematic reviews of e-Learning have been used more extensively in the medical education literature than in either the higher education or work-based e-Learning literature.

The following Table summarises the systematic reviews cited and the overall conclusion is that the evidence does not yet make a compelling case and that further carefully controlled studies are required.

| Authors | Surveyed | Papers found | Papers used | Verdict |
|---|---|---|---|---|
| Greenhalgh (2001) | CAL in UG medical education | 200 | 12 | Effectiveness still an open question |
| Rosenberg, Grad & Matear (2003) | Dental education | 1042 | 12 | As effective as other methods |
| Lau & Bates (2004) | e-Learning in UG medical education | - | 50 | Some evaluations favourable |
| Eynon (2004) | Web-based education | 383 | 6 | Better research needed |
| Curran & Fleet (2005) | Web-based continuing medical education | - | - | More research needed |
| Sanders & Walsh (2004) | e-Learning for GPs | 352 | 29 | Limited changes in learner behaviour |
| Childs, Blenkinsop, Hall & Walton (2005) | e-Learning for health professionals | - | 57 | Identified barriers to successful uptake |

Various of the reviews already cited make useful points with regard to the effectiveness of e-Learning. So Greehalgh (2001) points out that:

- Innovators who have developed apparently successful systems should be careful about making claims about the transferability of systems even when efficacy has been shown in research settings. This is a point that is related to context.
- Information on the success of students gaining access to a remote site should be part of any evaluation of educational technologies
- Tutors need have 'virtual skills' as neither course materials nor teaching skills can be directly transferable from the traditional lecture theatre
- Differences in the learning culture between online and traditional need to be recognized. The needs of the novice computer user are important
- Different developmental stages of online learning skills need to be taken into account or different learning styles
- Students often learn the skills when they need to use them (just in time learning) and too much initial training may not be effective
- Staff training should be a focus

- Integration with traditional teaching material is important
- Organisational culture, including resistance to change is a factor that influence the effectiveness of e-Learning

On a more organizational note, Childs, Belnkinsop, Hall & Walton (2005) found that:

- Organisational issues in e-Learning were of concern to managers both at national and local levels. Change management is required and resistance needs to be overcome. There is a time allocation issue when adopting and developing e-Learning programmes and the benefits to potential learners is not always apparent.
- No time is available to develop e-Learning programmes and to evaluate material. Commitment is needed from both the organisation and the trainers and this sometimes requires cultural change.
- Economic issues can create barriers and a need was identified for cost effectiveness/cost benefit evidence. Both trainers and learners were concerned about the costs of courses
- Managers are concerned about the evidence of the costs of e-Learning and cost effectiveness issues.
- Hardware is of concern to managers especially when the technology available is inappropriate or not used to its full potential. Learners are concerned are about the lack of, or inadequate, technology at work and at home.
- Software is a problem in terms of compatibility or when trainers lack the time to evaluate course software or develop materials.
- Lack of support for trainers is another barrier especially when they are required to provide support for learners
- Trainers can be reluctant to adopt new systems that disrupt established teaching methods. A number of myths about e-Learning act as barriers to its adoption and affect the way it is used in practice, for example, it is not as effective as traditional methods, it is demotivating and learners need to change their learning styles.
- Trainers need to be motivated to engage in e-Learning and computer anxiety and lack of computer confidence were factors. Learners were similarly resistant to change
- A blended approach, mixing face to face with online environments with learners managing their own learning seems to be the preferred option. Web based environments can enable learners to contribute more in discussion groups.
- Trainers and learners' lack of appropriate skills is of concern and sufficient time needs to be made available to redress the balance. Computer literacy should be demonstrated as a prerequisite for admission to e-Learning courses.

## *5.3 What are the learners' reactions to e-Learning?*

In this section we look at the reaction of learners to their learning experience. What did they think about e-Learning? Were they satisfied with their learning experience? What

did they think about the process? Previous reviews have shown that factors that influence the reaction of students to e-Learning include; levels of computer expertise, the skills of the novice computer user, computer anxiety, different online learning environments which require different skills and learning styles, and the students awareness of the potential of a particular system or application. The initial focus in this section is on interactivity, flexibility and ease of use and then issues of confidence, self-efficacy, and the influence of computer experience are raised.

Doyle (2002) referred to Kirkpatrick's four levels of evaluation in relation to the evaluation of medical simulation programs. He described the four levels as involving four kinds of measurement (1) Reaction/measurement of satisfaction – how did the learners rate their experience? (2) Measurement of learning – what skills, knowledge, and attitudes have changed? (3) Measurement of behaviour change – did the learners change their behaviour dependent on what was presented to them in the program? (4) Measurement of results – did the behaviour change have a positive effect on the organisation? He observes that although this particular paradigm is popular in business and education it is less well known in the clinical field. He further stated that few specific evaluations of medical simulation programs in the context of Kirkpatrick's four levels have been made. However even in the fields of education and business it is not often that all four levels of evaluation are used (see section 5 higher education and section 7 work-based e-Learning). We are using Kirkpatrick's four levels of evaluation in this review and have categorised studies according to where they fit in the hierarchy of levels of evaluation.

Doyle's (2002) review identified areas where evaluations can take place and systems that can be evaluated. He also identified Kirkpatrick's four levels of evaluation as useful in the evaluations of computer-based simulations in medical education. However there probably needs to be more discussion and acknowledgement of how evaluations focusing on all four levels could be achieved. To take account of all four levels of measurement would be recommended but maybe not always achievable due to the time and resources available for evaluation.

### 5.3.1 Perspectives on technology: Interactivity, Flexibility and Ease of Use

So what were the reactions of medical students and practitioners to learning using technology? Ease of use and intuitive navigation are highlighted by Gould (2001) when evaluating the use of multimedia technology to simplify the study of the brachial plexus. They administered a questionnaire to 23 first year students who reported that animations of development aided them in learning and retaining information about the brachial plexus. Written comments from the students indicated that a question test bank was useful but they wanted more interactivity. That is, they wanted correct answers to the sample questions with prompts on where in the program to look for information regarding answers, and information on why their incorrect answers were wrong. Bergin and Fors (2003) in their study using an interactive simulated patient found that most students (n = 70) found the interaction realistic and were positive about it. Interactivity was also highlighted by Levine (2002) who reported that first

year dental students (n = 113) found that the important features of web-based biochemistry lessons were the interactivity and flexibility. The ability to control the pace of the lessons and to review questions and exams with immediate feedback were seen as beneficial. He also suggested that familiarity with computers or computer experience can influence how useful a student finds a lesson.

But care needs to be taken in how computer based systems are designed and developed otherwise student's interest may be decreased (Masiello, Ramberg & Lonka, 2005). It would seem that although web-based learning has been advocated as a better teaching method, research has yet to show consistent teaching and learning advantages (Greenhalgh, 2001). In Masiello et al's study, 54 medical students gave their opinions on web-based learning which included (1) that there is a need for usability testing (2) web tools should complement rather than replace traditional lectures (3) the right learning management system needs to be used (4) flexibility is important in freeing learners from the necessity of traveling to campus (5) there needs to be clarity that e-Learning is not 'traditional campus-based learning in electronic form' (p 182). The students' attitudes to information technology in this study were favourable although they voiced dissatisfaction with the learning management system.

So how do medical students respond to new technology? The use of wireless handheld computers (PDAs) in a preclinical medical undergraduate curriculum was explored by Ganger and Jackson (2003). Twenty sophomore medical students were given PDAs which they used to access web-based course content, to participate in interactive teaching sessions, and to complete course evaluations. Just over half of the students found that advantages of the PDAs were the preparation for computer based examinations and the immediate availability of exam scores. However, most (70%) of the students still preferred to take an exam using a paper and pencil. In another study of the perceived effectiveness of PDAs Miller, Shaw-Kokot, Arnold, Boggin et al. (2005) found that nursing students' (n = 84) use and satisfaction with this technology was linked to access speed and reliability.

In 2005, Jackson, Ganger, Bridge, & Ginsberg reported a more extensive study in which wireless handheld computers had been implemented into all four years of an undergraduate curriculum (see also Ganger & Jackson, 2003 above). They suggested that the use of this technology facilitates the transition from a passive to an interactive learning environment in the classroom. By 2004 there were 1000 medical students who were using wireless pocket PCs (PPCs). These PPCs were used, for example, for attendance tracking, course evaluations, interactive learning where the tutor could modify the lecture based on the real-time feedback from the students, and medical decision making training students to use the mobile devices to aid diagnoses at the bedside. It was found that the use of the handheld devices facilitated interactivity even with large class sizes and motivated students to participate and assess their own knowledge base prior to exams. An unexpected finding was that it was useful for faculty training as it was discovered that some problem solving questions were not challenging and therefore not beneficial as a training tool. Students were happy with

the medical decision making facility that could be used as a medical reference tool in the clinic.

The technology for accessing the information and how this technology is used are factors contributing to the effectiveness of the learning. Another important factor is time – when the learning takes place and the widening choice of the students about when and how they learn. Third year dental students' (n = 65) and members of staff (n = 4) opinions were sought by Gupta, White and Walmsley (2004) about whether computer-aided learning (CAL) offers advantages such as learning in their own time and at their own pace. A web-based supplement to the dental undergraduate curriculum was developed. It was found that lecture handouts and textbooks were used frequently by most students (96%). The website was accessed by 86% of students mainly at the School of Dentistry, but 53% also accessed it at home. It was reported that students liked the multiple-choice questions, downloading extra notes and looking at pictures and animation to explain clinical procedures. Staff were also positive about the web-based supplement to the dental undergraduate curriculum but concerns were voiced about plagiarism, the effect on lecture attendance and the lack of feedback from students on existing CAL material. It would seem that tutors are wary of placing too much emphasis on web-based materials supplementing traditional methods of learning in the dental undergraduate programme.

Nurses also use web-based modules and Wilkinson, Forbes, Bloomfield & Fincham Gee (2004) report on an exploration of student post-registration nurses' perceptions of web-based modules on dermatology, diabetes, mentorship, and prescribing before and after completing the modules. 39 students were enrolled on the modules and pre-module data were collected on 74% (n = 29) and post-module data on 71% (n = 28). None of students had previous web-based education experience. 79% (n = 31) completed and 66% (n = 26) passed the modules. The level of IT skills prior to commencing the modules was reported to affect module completion and outcome. Wilkinson et al. stated that 'The modules were rated highly in terms of achieving learning outcomes with moderate ratings for level of support and utility of learning materials' (p 411). Flexibility was one aspect that was highlighted as positive whilst a negative aspect was that students thought that the learning could be isolated. It is pointed out that this form of learning may not be suited to all groups of nurses or all educational topics. This is an example of a case where the context can be the factor affecting whether an intervention is successful or not. In another study of student nurses (n = 96) using an online interactive multimedia-learning tool or text only, or text and images it was found that interactive multimedia group students were more satisfied with the method of learning, reported the technique to be enjoyable and more interesting, and that it provided sufficient feedback (Maag, 2004).

IT skills and ease of use is also an issue for individuals engaged in continuing medical education. Continuing medical education is provided to rural physicians through the use of distance learning technology. Curran et al. (2003) looked at physicians and nurses who participated in audio teleconference sessions (n = 16) and some who also accessed web-based learning systems (n = 18). The aim of the study was to assess the

usefulness of a mixed learning technology approach in providing distance continuing medical education. The users of the mixed learning technology (audio and web-based learning system) were satisfied with its ease of use. However the learners who accessed the system reported that they had high levels of computer skill and were therefore more confident. It would seem that one of the main advantages of the system was the opportunity for self-directed learning. Confidence is obviously a factor that facilitates the use of technology in medical education. It is also something that can be measured by asking the students – a self-report measure.

Interactivity can be an aspect of online continuing medical education (CME) and although research demonstrates positive outcomes of on-line CME programs, the effectiveness of and learners' satisfaction with interaction online is not high (Sargeant, Curran, Jarvis-Selinger, Ferrier, 2004). Sargeant et al. explored physicians' perceptions of and experiences in interactive online CME and factors influencing these. They used focus groups and interviews and recruited physicians based on their experiences with interactive on-line CME. They found that physicians' perceptions about access and technical competency were important. But they stated that two other themes emerged.

> The first was the capacity of on-line CME to meet individual learning preferences, which, in turn, was influenced by the quality of the program, the degree of self-pacing or self-direction, opportunity for reflection, and educational design. The second was the quality and quantity of interpersonal interaction, which was shaped by perceptions of social comfort, the educational value of interactions, and the role of the facilitator. Prior experience with on-line CME moderated perceptions (p 227).

The quality of the programme as perceived by the student was also found to be a factor that influenced effectiveness (Hahne, Benndorf, Frey & Herzig, 2005). Hahne et al. found that students (n = 167) initial enthusiasm for computer based learning was not maintained during the programme. They recommend careful piloting using a small but representative sample for any future programmes. This approach is characterising e-Learning as an innovation (Rogers, 2003) and suggesting that an attribute should be its trialability i.e. the extent to which it can be experimented with on a limited basis. This is because new ideas that can be tried out in a gradualistic or partial manner are generally adopted more quickly than those that are not divisible.

One omission in the majority of the literature on medical students' reactions to e-Learning is the longitudinal study. Dørup (2004) attempted to fill this gap in the literature with a longitudinal study of experience and attitudes among first-year medical students in Denmark. During the five-year study, 1159 medical students completed web-based questionnaires which assessed their IT readiness and their attitudes to using IT in their studies. Seventy two per cent of respondents indicated that they had access to a computer at home and this did not change significantly across the study period. However there were significantly more males than females who had access to a computer at home and males had a more positive attitude to using

a computer in their medical studies. In most studies discussing e-Learning and medical education the proportion of male and female participants is not reported. This study is therefore unusual although the findings are not reported extensively.

### 5.3.2. Understanding what is possible: Confidence and self efficacy

A key issue when discussing computer confidence and medical education is to ask whether this has changed over time. An intuitive answer would be yes. Certainly in e-Learning in higher education it has been shown that there was a difference in computer confidence over time, with later cohorts demonstrating greater confidence. In an early study by Osman & Muir (1994), 144 third year medical students were surveyed about their levels of computer skills and confidence in carrying out computing tasks. In terms of attitudes to computer aided learning (CAL), confident students were significantly more likely to rate CAL as easy and useful and significantly less likely to rate it as unpleasant. It was also found that gender was not related to confidence. The study differentiated between ever having done a task and the confidence to do the task unsupported. This means that measures that do not take confidence into account in the independent use of CAL may overestimate student capacity. It was concluded that explicit instruction on a small group basis can lead to an increase in confidence. This paper is dated (12 years old) but may still have some relevance. Are medical students' experience and computer skills very different now? The previous finding that gender is not related to confidence is interesting when contrasted with Dørup's study where males had more positive attitudes to using computers in medical studies.

Confidence is linked to self-efficacy which according to Potosky (2002) is 'the belief in one's capabilities to mobilise the motivation, cognitive resources, and courses of action needed to meet given situational demands' (p 242). Jaffe (1997) posed a question in relation to whether interactive media can better educate people about complex health issues. In terms of learners' reactions he asked - Do users develop greater levels of self-efficacy in a content domain when they obtain information within an interactive media format? Here perceived self-efficacy is defined as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. Jaffe hypothesised that individuals would exhibit greater gains of self-efficacy if they accessed relevant information using hypermedia rather than through non interactive media. This is an interesting study and will be described in more detail in a later section as a number of his predictions are related to the quality of learning. In relation to self-efficacy and confidence Jaffe found (using a self-report measure) that people who preferred to use help when using interactive media increased their self-efficacy.

When horizons are expanded and students can see what it possible with e-Learning there is often an increase in confidence. Lechner, Kandlbinder, Gonsalkorale, Bradshaw et al. (2001) describe a program that gave senior dental students the opportunity to enhance their confidence in planning oral rehabilitation. It also exposed them to treatment options from different universities and enabled them to form links with overseas students and enhance their awareness of the patient in the planning process. The sample size was small, consisting of one tutor and 12 students from five different universities. Confidence was measured using student feedback

questionnaires where students confirmed that the program was easy to use and that their confidence in planning oral rehabilitation had been enhanced through using simulated patients. This means that, although there were a number of interesting aspects of this study, self reported confidence measures of 12 students cannot be accepted as a robust finding. However this paper did include an example of the type of study that could be expanded.

Another example of self-reported effectiveness was a study to assess the utility of internet-based training in airway anatomy and evaluation. Euliano, Lee, Melker & Schmalfuss (2003) looked at whether 80 individuals (including medical students, nurses and surgeons) who completed pre and post tests on airway evaluation found the internet based training useful. The majority of students felt that their knowledge of airway examination improved after completion of the virtual tasks on the internet site. This essentially means that their confidence had increased.

The issue of confidence is not directly mentioned but is implicit in a study by Weicha, Gramling, Joachim & Vanderschmidt (2003) who believe that advances in electronic technology have created opportunities for new instructional designs of medical curricula. They described a qualitative study with ten students from two medical schools after a 4-week online elective course for medical students to teach the cognitive basis for interviewing skills. The students firstly studied online modules on interviewing concepts and viewed videos illustrating the concepts. They then participated in asynchronous discussion groups designed to reinforce course concepts, stimulate reflective learning, and promote peer learning. The results of this study included the learners reporting (1) improvements in self-awareness (2) increased understanding of interviewing concepts. This is related to the information processing theory of learning. Participants reported high levels of satisfaction with online learning and with achievement of course objectives. Self-reported knowledge scores increased significantly from pre-course completion to post-course completion. Weicha et al. argue that online education has significant potential to augment curriculum on the medical interview, particularly among students trained in community settings geographically distant from their academic medical center. This study included two aspects that are related to the effectiveness of e-Learning in medical education. Confidence is implicit in the students reporting that they increased their knowledge and that they were happy with online learning and their achievement of course objectives.

A large number of studies in the medical education literature use questionnaires to assess whether an e-Learning experience has been a success. This is a self-report measure of success and there might be some demand characteristics at play where students are responding in the manner in which they understand the researchers want them to respond. Very few of these studies are longitudinal so the measure of effectiveness is the students' reaction to their learning immediately after the experience. This sparsity of longitudinal studies in the medical education literature is a gap in the literature on the reactions of learners to their e-Learning experience.

### 5.3.3 Summary: Perspectives on technology

The students' and practitioners' reactions to e-Learning concur with previous reviews which have shown that levels of computer expertise and the skills of the novice computer user are important. Although computer anxiety is not mentioned specifically in our review, related issues were raised linked to self-efficacy and confidence. The way in which a student approaches a particular learning environment and learning experience has an influence on how successful that experience is . Different online learning environments require different skills and the student's awareness of the potential of a particular system or application (e.g. using help facilities) has an influence on success. This has links to the issues of flexibility and interactivity identified in our review.

The gaps in the literature lead us to recommend that more research is undertaken that includes

* Longitudinal studies
* Qualitative studies that look at the student experience in depth,
* Studies that look at the experience of the off-campus or long distance learner

## *5.4 What is the quality of the learning?*

In this section we look at the quality of the learning experience. Is there a learning gain? Does interactivity improve the quality of the learning? Additional measures include comparisons between classroom learning and e-Learning, individual differences in learning, and the effectiveness of the type of course. The measures of learning addressed in the higher education literature e.g. learning gains in terms of attainment and achievement are also relevant in medical education. Past reviews of e-Learning in medical education have found that tutors need to have 'virtual skills' as neither course materials nor teaching skills can be directly transferable from the traditional lecture theatre. This can have a direct impact on the quality of the learning. The differences in the learning culture, between online and traditional approaches need to be recognised. A blended approach, mixing face to face with online environments and with learners managing their own learning seems to be the preferred option. In two separate reviews of computer assisted learning it was shown that in about half of the studies, the participants had greater learning gains in the online or blended learning condition which means that there is still a need for a component of face-to-face teaching.

### 5.4.1 Interactivity and the quality of the learning

Interactivity has already been discussed in the previous section in terms of students' preferences. Interactivity can also be a factor that influences the quality of a learning experience. As Bergin and Fors (2003) point out 'The clinical encounter between the patient and the professional is crucial in all healthcare areas' (p 361). This encounter, for medical education students, has become increasingly problematic as there is a shortage of "good educational cases" because most straightforward patient cases are dealt with outside university clinics. Other reasons include the shortened clinical training for students and that for ethical reasons some patients are not suitable for the

students to work with. To counter these problems Bergin and Fors (2003) developed an interactive simulated patient (see also Bergin et al. 2003 below).

But how well does this interactive media work? An early study by Jaffe (1997) explored whether the students (n = 72) gained greater knowledge if they controlled the information sequence in interactive media and whether different information processing styles influence the manner in which media interactivity affects self-efficacy in a particular knowledge domain. The findings from this study included:

- The higher interactivity group (who could control the information sequence in interactive media) did not show higher degrees of conceptual knowledge
- The interactive media users who indicated a preference for help-hints showed greater self-efficacy gains than those who preferred perseverance or those who used less interactive media.

This is an interesting paper that relates self-efficacy to use of interactive media. Jaffe argued, based on his findings, that interactive media, including hypermedia, may not be the 'magic bullet' technologies for improving health knowledge and behaviour i.e. it is not always effective.

Interactive media and collaboration were the focus of Bergin, Parvati, Youngblood, Ayers et al.'s (2003) study where they developed an interactive simulated patient (ISP). This computer based simulation tool was designed to provide the opportunity for medical students to practice their problem-solving skills, such as laboratory investigations, physical examination, and clinical decision-making, in a virtual learning environment. The aims of this study were to 'investigate the extent to which the ISP system was able to engage and motivate students and to explore ways in which it promotes collaborative learning among students in pairs at each location (local trials) or in triads at geographically dispersed locations (global trials)' (p 388). Fifty-two male and female medical students from the Swedish and US universities took part in local trials and 6 students, 2 from USA and 4 from Sweden took part in the global trials. Data obtained was from questionnaires, and individual and focus group interviews where there was both videotaping and observation. The results showed that 92% of the students in the local trials preferred collaborating in pairs when working with both paper-based and computer-based cases. In the global trials the students found collaboration with students at the other two sites to be useful. However they also agreed that it would have been easier to collaborate if they could have seen each other's computer screens. In the local trials most students found the ISP virtual environment more fun and realistic than the paper cases. Some students felt that the paper-based case and the ISP-VL were incomparable as they promoted different ways of learning and focused on different skills. However it was observed that 'the level of interaction, discussion, engagement, and laughter (the fun factor) was much higher when the students were working with the ISP-VL cases than when working with the paper-based cases' (p 396).

### 5.4.2 Comparing the quality of the learning

Is there a difference between classroom teaching and learning on the web or from a CD-ROM? Are different types of online learning or a combination of online and face to face learning more effective? Does the context and what is being taught play a part?

In a large-scale, straightforward comparison between online CD ROM training and instructor-led training for nursing staff (n = 1,294) it was found that the computer-based training was significantly more effective than the face to face instruction based on performance on a knowledge test (Harrington and Walker, 2004). The training was on a fire-safety programme and it was found that the online learners took less time to complete their training than the instructor led group. In a comparison between a web-based graduate pharmacology course and a face to face pharmacology course for nursing students (n = 70) it was found that there was no difference between the two groups on examination scores (Bata-Jones & Avery, 2004). These different outcomes in comparative studies indicate that the contextual nature of the learning i.e. training in fire-safety or graduate pharmacology may have an effect on whether online or face to face is more effective.

Other studies make comparisons between different types of computer assisted learning. One study compared the effectiveness of a learner control vs a programme control multimedia learning environment on the performance (assessed by multiple choice questions) of 30 dental students (Aly, Elen & Willems, 2005 ). There was no difference in performance between the students who controlled their own learning environment and the students who received a structured version of the programme. Another study compared the performance (assessed using final examination scores) of beginning medical students (n = 82) who used one of 3 different CD Rom modules that had been developed to teach histological images (Lei, Winn, Scott & Farr, 2005). Students who used more than one of the CD ROM modules performed significantly better on the final examination and there was also a significant relationship between perceived effectiveness of the module and examination performance.

In the medical education field there is recognition that there is a problem with the way that auscultation of the heart (identification of abnormalities, circulation and homeostasis) is taught. Finley, Sharratt, Nanton, Chen et al. (1998) point out that auscultation of the heart is poorly taught in both medical schools and in residency programmes. They compared classroom teaching of auscultation (n = 19) with the use of a CD-ROM auscultation teaching programme (n = 21). Both groups used recorded normal and abnormal heart sounds and murmurs. The classroom group scored consistently higher than the CD-ROM group on unstructured questions but both groups performed similarly on multiple choice questions. The overall effectiveness of the teaching seems to be similar between classroom and CD-ROM teaching with the unstructured questions being better handled by the classroom group. The findings from this paper could be construed as an argument for a flexible blended approach to learning.

In a more recent study Karnath, Carlo & Holden (2004) investigated learning of pulmonary auscultation using computer-based learning alone or combined with faculty led teaching it was found that there was no difference in learning between the students who used computer-based learning alone (n = 113) compared to the students who used computer-based learning combined with faculty led sessions (n = 79). However the students who received faculty teaching did perform better than those that did not although this difference was not significant.

The deficiency in cardiac auscultation amongst medical students and other post-graduate trainees when conducting physical examinations is also acknowledged by Torre, Pfeifer, Lamb, Walters et al. (2004). The objectives of their study were to see whether technology-based, self-directed learning tools could enhance the cardiac auscultation skills of 18 third year medical students. The students attended a one hour cardiac auscultation lecture and also used a self-directed technology-based learning tool (web or PDA) during rotation. A comparison group consisted of 13 internal medicine residents who attended, solely, the cardiac auscultation lecture. It was found that the students who had used the self-directed learning tools as well as attending the lecture correctly identified more computer simulated heart sounds/murmurs than the internal medicine residents. The argument about what works in this paper is about the combination of traditional lectures and multi-media, technology-based, self-directed learning tools for producing an effective resource for teaching cardiac auscultation skills. Self directed learning becomes even more important for both students and practitioners who need to study at a distance.

Distance education is now becoming an important part of medical education as there is a move from the campus and into the community (Malloy, 2002). Malloy carried out a study where he compared student performance in an objective structured clinical exam after using an enhanced web-based study case (which was interactive) compared to a simple paper case which was not enhanced with visuals or referrals to a web-based case. Eighty seven students were part of the group who used enhanced materials and 91 students were part of the group who did not use the web materials. The scores for the two groups in the clinical exam were not significantly different, in fact, they were very similar. It is suggested that enhanced visual distance education cases may offer no distinct advantage over simple paper case study guides.

An alternative view is offered by Kumta, Tsang, Hung, & Cheng (2003) who argue that conventional lecture based teaching is not well designed to support analytical thinking and problem solving skills in final year medical students. They suggest that the fostering of critical thinking skills could be achieved through a web-based tutorial programme for final year medical students. Multimedia enhanced web-based tutorial programmes were used to supplement an existing programme for final year students in orthopaedic surgery rotation. One hundred and sixty three final year medical students (in groups of 15 students) were randomly assigned to an intervention (N = 89) or a control group (N = 74). These students were tested for their clinical examination skills, critical thinking abilities, and factual knowledge based on curricular requirements. The intervention group was presented with a patient oriented clinical

problem which they had to solve. They could only proceed to the next part of the tutorial when they had typed a response explaining their clinical decisions.

The personal touch is evident in this study where the researchers acted as moderators by participating in web discussions and providing formative feedback. Each group of students also met their facilitator three times a week. The students could log in from any terminal and discuss the eight clinical case studies representing orthopaedic problems. The control group attended lectures, bedside tutorials, ward attachments, and outpatient clinics. The teacher contact in both the intervention and the control group was similar. At the end of the 3 week module students were assessed by computer based assessment, a clinical examination test and also with patients on the ward. There was no difference between the two groups on the premodule test results. However when the postmodule results were compared the mean score for the intervention group was significantly greater than the control group. There was also a significant difference in the time spent in the wards beyond that allocated for bedside tutorials with the control group spending an average 5.15 hours and the intervention group spending 7.0 hours. This could mean that the scenarios provided to the intervention group provided them with the confidence to engage in clinical problem solving.

The designers of this intervention wrote enthusiastically about their intervention and had obviously put a lot of time and effort into it. They were almost willing the intervention to work. However they acknowledge this factor 'The enthusiasm of the facilitators … and the intensification of their interaction with students may have been significant contributing factors'. They argued that web based tutorials stimulate students to think and may complement the teaching resources of clinical departments. It could be added that the enthusiasm and involvement of the researchers in these circumstances also had an impact and contributed to the effectiveness of the intervention.

In order to use distance education effectively, healthcare professionals need to be prepared. Bangert et al. (2002) interviewed 57 healthcare professionals - the majority of whom were doctors. The aim of their study was to conduct an educational needs assessment as part of an overall programme to create a set of web-based interactive distance learning modules. These interactive modules were designed to enhance the utilisation of telemedicine by health care providers an dimprove the quality of the learning. The study identified four learning clusters (1) fundamentals of telemedicine (2) clinical applications (3) organization and management (4) technical systems. These clusters informed the structure of the web-based interactive curriculum.

### 5.4.3 Summary: Quality of learning

The educational or training context was an important factor that influenced how well an e-Learning intervention worked, as different studies came to conflicting conclusions. A key factor is the personal involvement and enthusiasm of the facilitators.
Previous studies have confirmed that the contextual differences means that it is difficult to make comparisons across studies. Even when comparisons are made there are conflicting results as to whether blended learning works better than traditional learning.

We recommend that any comparative study of the quality of e-Learning in medical education should also use at least one other level of evaluation. The contextual nature of learning can be explored at the individual level through gauging the reactions of the learners either through self-report or observation of their behaviour (or both), or at the organisational level by looking at the impact that e-Learning has on the institution or organisation. We also recommend that more qualitative studies looking at the influence of the personal involvement of the tutor are undertaken.

## *5.5 Does e-Learning alter the behaviour of the learner?*

In this section the evidence for whether e-Learning changes the behaviour or performance of the learner is examined? In a review of e-Learning for general practitioners, Sandars and Walsh (2004) found that there is increasing interest in e-Learning for general practitioners (GPs) in the UK. However after reviewing the literature of the past five years in which e-Learning had been used by GPs they found that only two studies were identified which resulted in changes in clinical or professional behaviour. They found that one study used an educational intervention with feedback on performance that they categorised as complex. In another study they found that the intervention included a combined online course and discussion group. When we look at students' behaviour in relation to learning we can observe that their behaviour is influenced by what they need to know at that time. In a review of CAL, Greenhalgh (2001) suggests that students often learn the skills when they need to use them (just in time learning) and too much initial training may ineffective.

The virtual linking of a central academic intensive care unit (ICU) with multiple community hospital intensive care units is an example of the campus to community learning can be facilitated through e-Learning. A question related to this approach is - can the use of handheld computers change the way that information is accessed by physicians? That is, can the use of these devices change behaviour? Lapinsky, Wax, Showalter, Martinez-Motta, Hallett et al. (2004) in a Canadian study suggested that critical care physicians may benefit from immediate access to medical reference material. This could be achieved through using handheld devices. Lapinsky et al. evaluated the feasibility and potential benefits of a handheld computer based knowledge access system linking a central academic intensive care unit (ICU) to multiple community-based ICUs. Seventeen physicians participated in the study from four community hospital ICUs. After training in the use of an internet-linked,

updateable handheld computer knowledge access system the physicians used the handheld devices in their clinical environment for a 12-month intervention period. The intervention was evaluated by tracking use of the handheld computer and by conducting surveys and focus group discussions. Before and after the intervention period, participants underwent simulated patient care scenarios designed to evaluate the information sources they accessed, as well as the speed and quality of their decision making. Participants generated admission orders during each scenario, which were scored by blinded evaluators.

The results from this study showed that ten physicians (59%) used the system regularly, but predominantly for non-medical applications. Eight out of 13 physicians (62%) who completed the final scenarios chose to use the handheld computer for information access. This group exhibited a significant improvement in admission order score as compared with those who used other resources. It was concluded that an updateable handheld computer system is feasible as a means of point-of-care access to medical reference material and may improve clinical decision making. However, it was acknowledged that acceptance of the system was variable. Improved training and new technology may overcome some of the barriers that were identified. This is very definitely an area where more research is needed.

Jackson et al. (2005), in a US study, have already implemented handheld devices into all four years of a medical undergraduate curriculum. This is bound to have an effect on medical practice as these students who have expertise and an understanding of the potential of handheld devices join the medical workforce. Does the behaviour of the practitioner change through the use of handheld devices? Is information more readily at hand? And does the immediacy of the information at the fingertips change the decision making process? These are some of many questions to still to be asked. Miller, Shaw-Kokot, Arnold, Boggin et al. (2005) in a US study of nursing students (n = 84) found that the students made substantial use of their PDAs and health team members while decreasing their reliance on textbooks and clinical faculty. Interestingly, it was also reported that student use of PDAs increased when faculty were observed using PDAs. This has links to the finding in the higher education literature on laptop use (Demb et al. 2004) where students' perceptions of the value of the laptop to their academic success were tightly correlated with their perception of the success of faculty in integrating the laptop into teaching and classroom activity. Miller et al. recommended that faculty should be provided with PDAs in order for them to become comfortable with their operation and consequently enhance the incorporation of PDAs into clinical teaching.

The introduction of computer assisted learning (CAL) into an undergraduate psychiatry course can potentially change the behaviour of the learners (Guerandel, Fell & Malone, 2003). Guerandel described an interactive e-Learning environment that was created to assist students in acquiring the necessary skills in undergraduate psychiatry. The pilot phase of the study consisted of providing the students' lectures on-line on the interactive site. Data were gathered from the last group of students in 2001 (pre-CAL-PSYCH, n = 23) and the first group of students using CAL-PSYCH

in 2002 (n = 24). Assessment of percentage of students accessing the site, attendance rates at face-to-face lectures and tutorials, and also a feedback questionnaire from students who accessed the site were collected. In terms of the behaviour of the learners it was found that attendance at the face-to-face sessions was not affected by the introduction of the computer assisted learning element. This is an argument for the value added aspect of e-Learning.

### 5.5.1 Summary: Changing learmer behaviour

The increase in students' use of PDAs when faculty were observed using them, is of interest and has links to findings in the higher education literature. This also has links to the adoption of new ideas/diffusion of innovations model where some of the attributes of an innovation need to be taken into account. Can it be seen to be better? Can it be seen to work? In relation to the students' observation of faculty using the PDAs, it means that students can see if it is successful. In another study the behaviour of students was monitored and it was found that the use of online materials did not decrease attendance at face-to-face lectures.
Previous reviews have shown that there is very little evidence available on the effect of e-Learning on the behaviour of medical students and practitioners. It has also been found that students often learn the skills only when they need to apply them. By contrast new technology (handheld devices, PDAs) can alter behaviour by changing the way that both students and practicing doctors access information and make decisions. But context is still important. Acceptance of the devices was variable and improved training is recommended.

The gaps in the literature lead us to recommend that more research is undertaken that includes
* Exploration of student, practitioner (especially GP) and faculty use of handheld devices.
* More observational studies of student behaviour in coordination with self-report methods. This will lead to more robust triangulated findings.
* More studies that look at the impact of online learning on attendance at face to face sessions.

## *5.6 What is the impact of e-Learning on the health organization including the community?*

In this section the impact of e-Learning on the organization is examined. What are the organisational effects resulting from the trainee's or learner's performance? What are the more wide-ranging effects? What are the problems at the organisational level? Previous reviews have shown that organisational culture, including resistance to change is a factor that can influence the effectiveness of e-Learning. It has been acknowledged that organisational issues in e-Learning were of concern to managers both at national and local levels and that there is a requirement for change. An understanding of the benefits to potential learners was not always apparent and there was often no time available to develop e-Learning programmes and to evaluate

material. In addition, trainers can be reluctant to adopt new systems that disrupt established teaching methods.

Under-utilisation of e-Learning resources is a problem at the organisational level. This can have links to the diffusion of innovations model where some of the attributes of an innovation need to be taken into account. Is e-Learning or more specifically the type of learning with technology that is being introduced compatible with the organisational culture? Is it too complex for the people to understand? Can it be tried out without taking it on in its entirety? And finally, can it be seen to be better? Can it be seen to work?

Organisational issues are discussed by Bangert, Doktor, and Johnson (2002) in a USA centric paper who point out that telecommunication technology have been used in delivering medical care in the private sector for well over 50 years. They state that a major cause of failure of telecommunication technology (telemedicine) is the low utilisation by the healthcare professionals who are supposed to benefit from it. They cite examples such as (1) mismatched technology where one hospital's equipment fails to communicate with another hospital's (2) outdated technology (3) over-reliance on the technology where organizations expect the technology, not the people, to fill gaps in a project. The consequences of these technological hitches at the socio-organisational level is an under utilisation of the system. This presents itself in a number of different ways (1) low utilisation of the system because it is poorly marketed to potential users (2) lack of belief in the system which means that doctors believe that the technology will not help them in their diagnosis and prefer the 'hands-on' approach (compatibility) (3) the doctor's fear of the telemedicine or its potential complexity leads to under utilisation of the system.

When we move beyond the organisation and look at the societal effects that e-Learning can have on the education of medical students it is interesting to look at the case of open source material where new clinical cases can be incorporated into a multimedia internet-based teaching tool. McClennen, Nathanson, Safran & Goldberger (2003) created a multimedia internet-based electrocardiogram (ECG) teaching tool. When usage data of this tool was analysed for 17 months it was found that there had been 4105 distinct uses of the program. The majority of users were physicians or medical students. McClennen et al. argue that easily-expandable, freely available resources for ECG pedagogy can complement traditional methods of instruction. This is also presumably a low cost way to complement and support traditional methods of instruction.

Cost effectiveness is an important issue for educators in medical education but there other organisational issues that impact on the effectiveness of e-Learning. The training of faculty in the developing and implementing of online instruction is necessary in medical education (Sleight, Reznich, Yelon & Williamson, 2003). As has been mentioned by other researchers (e.g. Malloy, 2002) the movement to situate family medicine clinical education in community settings is well advanced. In order for geographically dispersed medical students to receive quality instruction at a distance,

the World Wide Web is being used increasingly (this is certainly the case in the USA but perhaps less so in the UK). To these ends faculty need to be suitably skilled at creating educationally sound, well-designed online instruction. Sleight et al. (2003) found that out of 15 faculty who took part in the 'creating online lessons' seminar series, 8 completed and 4 implemented their online lessons. One of the reasons for not completing the seminars and implementing the online lessons was lack of time – faculty found that work got in the way. This is an example of the need for the recognition of the benefits of an innovation before time is invested in gaining expertise in using it. In the diffusion of innovation literature (Rogers, 2003) this would be referred to as trialability where something can be tried out without taking it on in its entirety.

There is a wide range of literature on distance medical education from the USA, Canada and Australia but less from the UK. However issues relating to distance education are global and therefore still relevant to the UK. Sandars and Walsh (2004) point to the socio-technical issues that need to be overcome if the potential of e-Learning is to be realized by general practitioners in the UK. This again raises the issue of the attribute of an innovation in the form of trialability. How can GPs try out e-Learning without taking it on in its entirety? Harden (2005) described an international virtual medical school and argued that 'e-Learning provides a bridge between the cutting edge of education and training and outdated procedures embedded in institutions and professional organisations'. Here we are talking about the potential of e-Learning to transform organisations through its ability to reach beyond the organisation and out into the community. This vision can be realised but only when resistance to change is overcome through the conviction that there is something better on offer. Is e-Learning or more specifically blended learning better than traditional learning alone? The answer is always going to be it depends on the context. That context includes the student, practitioner, faculty, learning content and the technology itself.

### 5.6.1 Summary: Impact on the health organisation

Lack of time is a factor that influenced the effectiveness of e-learning In terms of what doesn't work, under-utilisation of e-Learning resources is a problem at the organisational level. This under-utilisation includes mismatched technology, outdated technology, and over-reliance on the technology.

The gaps in the literature lead us to recommend that more research is undertaken that includes

* Longitudinal studies of the pattern of adoption of e-Learning in organisations
* Comparative studies of the adoption of e-Learning in different health organisations or in different health practitioner populations
* Use of the diffusion of innovations model to guide research programmes in the implementation of e-Learning into an organisation

# 6. How compelling is the evidence for the effectiveness of e-Learning in Work-Based Learning?

> An innovation presents an individual or an organization with a new alternative or alternatives, as well as a new means of solving problems. However, the probability that the new idea is superior to previous practice is not initially known with certainty by individual problem solvers. Thus, individuals are motivated to seek further information about the innovation in order to cope with the uncertainty that it creates. (Rogers, 2003 p xx)

## *6.1 Introduction*

This chapter surveys recent research on the effectiveness of work-based e-Learning. In the first part e-Learning and work-based learning are defined, the contexts in which work-based e-Learning takes place are described and previous reviews are summarised. In the second part, the evidence on the effectiveness of e-Learning in the workplace is presented using Kirkpatrick's (1998) levels of evaluation.

## *6.2 Definitions*

It is difficult to make a clear distinction between learning and training when examining the work-based e-Learning literature. For example work-based Learning (WBL) has been defined as:

1. Training which is undertaken in the workplace or a simulated work environment which may include structured training and/or assessment, observation of work practices, practicum, case study or other models. (www.training.wa.gov.au/publications/cbt/framework/glossary.htm)
2. Learning for work, learning at work, and learning from work (Seagraves, Osborne, Neal, Dockrel, Hartshorn & Boyd, 1996)

The first definition presents work-based learning as training while the second uses the term learning but leaves the description open to interpretation. These definitions do not explicitly link learning in the workplace to higher education. The University of the West of England description of WBL however offers a focus on the link between higher education and WBL: 'Work Based Learning reflects a range of learning activities that are embedded in academic programmes and take place in a workplace. The purpose of the experience is multi-faceted. This ranges from experiences with clear objectives and outcomes related to improving application of theory to practice and vice versa, to enhancing core and key competencies related to the subject area, and improving employability'( University of West of England, 2005).
A related definition is that of web-based training: 'Delivery of educational content via a Web browser over the public Internet, a private intranet, or an extranet. Web-based training often provides links to other learning resources such as references, email, bulletin boards, and discussion groups. WBT also may include a facilitator who can provide course guidelines, manage discussion boards, deliver lectures, and so forth. When used with a facilitator, WBT offers some advantages of instructor-led training while also retaining the advantages of computer-based training' (learningcircuits, 2005).

In a 2005 Becta report 'Research into the use of ICT and e-Learning for work-based learning in the skills sector' a definition of work-based e-Learning is proposed 'The delivery and administration of learning opportunities and support via computer, networked and web-based technology to help individual performance and development, undertaken in or linked to the workplace'.
Some researchers do make a distinction between learning and training. In a review of the existing and potential role of e-Learning in small and medium sized organisations (SMEs) Sambrook (2003) suggested that human resource development is moving away from training and towards learning. She explored the relevance and usefulness of ideas of lifelong learning, e-Learning and work-related learning in relation to small organisations. Lifelong learning is perceived as important for learning organisations as it supports their need to cope with technological change, e-Learning is defined as any learning activity that is supported by ICTs and work related learning is defined as learning relevant to work that takes place both in and at work, as well as outside the workplace.

For the purpose of this review we include papers that summarise blended learning, e-Learning, online learning and also training. It would be useful to be able to draw clear a demarcation line between what is training and what is learning but it is not that simple. The literature is wide-ranging and sometimes the term e-Learning in one paper means training whilst a report on what purports to be training can give an insight into the learning process. We can see from the definitions presented above that the distinction between training and e-Learning is not entirely clear. In order to get a clearer view of work-based e-Learning (WBeL) we first look at where it takes place.

## *6.3 Contexts in which work-based e-Learning takes place*

This review focuses on the evidence of the effectiveness of e-Learning in the workplace ithout the necessity for links to higher education. However where there are links to higher education these are discussed.

### 6.3.1 Corporate Universities

Corporate universities are described by the Henley Management College (2000) in this way: 'A corporate university is formed when a corporation seeks to relate its training and development strategies to its business strategy by co-ordination and integration and by the development of intellectual capital within the organisation in pursuit of its corporate aims and objectives'. The corporate university may be physically located or operate virtually.

The driving force behind the formation of corporate universities is companies' needs to organise their training, maximise investment in education, manage change in the organisation, spread cultural norms and values, enhance the employability of the workforce and hold on to the competitive edge in the marketplace (Dillich, 2000; Hearn, 2001). Hearn (2001) described organisations in the USA that have established corporate universities: Motorola use virtual reality in its manufacturing training, The Boeing Company focus on the development of leadership skills with a web-based

curriculum, United Health use distance learning technology to provide access to course work, and the Ford Motor Company offer training via a digital worldwide network.

Taylor (2003) suggested that corporate universities (CUs) are a corporate response to educational deficiencies and that the boundaries between education and business are becoming less distinct. The corporate university serves the needs of people within that organisation. For instance, Motorola University - one of the first corporate universities - provided basic numeracy and literacy skills for employees who had missed out on a full education. Taylor (2003) discussed the CUs in terms of higher education symbolism and practice and points to the utility of the term for raising the status of training and development through 'relabeling'. He suggested that higher education has been getting closer to corporations through the funding of academic posts and students by multinationals. Corporations have also been getting closer to higher education in their emulation of and perhaps their competition with HE institutions (Taylor, 2003).

Birchall and Woolfall (2003) in their UK report on corporate e-Learning discussed five companies who aim to 'improve overall productivity through e-Learning' (p 3). They also interviewed senior learning and development executives in manufacturing, retail, defence, telecommunications, professional services, aggregates and automotive services. Looking to the future they assert that the focus should be on increasing 'levels of learner engagement and participation, integrated approaches to design and delivery, a stronger business case and the effective management of resulting projects' (p 2). They make a key point about evaluation – there needs to be an improvement in how the impact of e-Learning 'on the bottom line' is evaluated, otherwise senior management will be unconvinced of the business benefits.

### 6.3.2 University for Industry (UfI) and Learndirect

UfI Ltd is the organisation responsible for 'Learndirect', the largest government-backed supported e-Learning initiative in the world. Ufi was established in 1998 by the government to take forward the concept of a 'university for industry'. The aim was to use e-Learning to boost the employability of individuals and the productivity and competitiveness of organisations (University for Industry, 2005). UfI has a network of more than 2,000 Learndirect centres in England, Wales and Northern Ireland and 6,000 UK online centres in England. Ufi provides access to a range of e-Learning opportunities through these centres. The difference between UfI and corporate universities is that a corporate university is developed by a specific company or organisation and will communicate that corporation's values and culture. In addition, corporate universities look to emulate higher education.

Learndirect has a slightly different aim to that of corporate universities - its mission and the outcomes so far, are described below:

> Learndirect's flexible learning is available to individual adults wanting to improve existing skills or to learn new ones, and to employers looking for an innovative way to develop the skills of their workforce. Since its launch in 2000 1.3 million learners have enrolled

> on almost three million learndirect courses. Learndirect offers more than 550 different courses covering a range of subjects, including management, IT, Skills for Life and languages, at all levels. More than three quarters of the courses are available online allowing people to learn wherever they have access to the internet – at home, at work or at a learndirect centre. (UfI, 2005)

'Learning through Work' is part of Learndirect and presents individuals and work-based groups with an opportunity to get university qualifications without leaving the workplace. Specific programmes are designed to build on existing skills and knowledge and focus on work-related learning. A number of UK universities are involved with this scheme.

### 6.3.3 Small and Medium Sized Enterprises (SMEs)

SMEs, particularly those with less than fifty employees, were the focus of the government attention when they were setting up the University for Industry (UfI) and more specifically Learndirect. The aim of the initiative was to increase the take-up of learning by SMEs and consequently raise the skill levels in the UK thereby creating potential for productivity and improved business performance. UfI commissioned a survey in 2002 to assess the attitudes within SMEs to e-Learning and also their awareness of Learndirect. This survey showed that it was the larger SMEs (51 – 250 employees) who were more likely to invest in online learning. The smaller and medium sized companies indicated that they would prioritise management and executive staff for online learning provision while in the larger companies it was the technical and clerical staff that would be prioritised.

There are, therefore, at least four strands of evaluations and reviews taking place within work-based e-Learning.

1. There are those linked to corporate universities which are 'in-house' evaluations generally confirming that e-Learning is beneficial for the company.
2. Reviews and surveys carried out for UfI to canvas the views' of companies, and employees within the companies with regard to e-Learning. Although the UfI's focus is on SMEs, one large survey looked at companies with 500+ employees (Hills and Kappler, 2004). This study indicated that UfI perceives a need to understand what happens in larger organisations that are using e-Learning or planning to use it.
3. Reviews and reports looking at corporate e-Learning (Birchall and Woolfall, 2003) and e-Learning in large SMEs (Hills and Kappler, 2004).
4. There are also reviews that draw together literature on e-Learning to answer a specific question or questions.

All these types of reviews will be discussed briefly in the next section and then incorporated into the relevant sections throughout this review.

## *6.4 What have previous reviews concluded about the impact of WBeL?*

### 6.4.1 Corporate e-Learning: delivering business benefits

In a report on corporate e-Learning Birchall and Woolfall (2003) investigated the problems and solutions that have arisen as senior managers have begun to use e-Learning to deliver business benefits. They also explored the trends affecting the future shape of e-Learning. They concluded that although e-Learning has fulfilled its promise in terms of delivering training more cost-effectively there is an urgent need to achieve greater levels of learner engagement and participation. These are all issues related to motivation and self efficacy that will be discussed in the second part of this paper. They further argued that 'From a strategic perspective, to develop a culture essential to support new ways of delivering learning requires firm commitment and leading by example at senior level' (Birchall and Woolfall, 2003 p 2). These recommendations relate to attributes of innovations (Rogers, 2003) such as 'observability' that will be discussed in the next section of this review. In terms of future developments Birchall and Woolfall argued for a varied approach with a number of delivery formats including highly structured e-Learning, blended learning and self-managed informal learning.

### 6.4.2 Embedding e-Learning in large organisations

Hills and Kappler (2004) in a Learndirect initiated review, surveyed 503 large UK companies (500+ employees) about their use of e-Learning. They found that changing attitudes was the greatest achievement of e-Learning. They compared the 'embedding of e-Learning' in different types of organisations and found that 29% of users in business service companies considered e-Learning to be well-embedded whilst fewer (11%) of those in public service companies considered e-Learning to be well-embedded. Although changing attitudes was considered to be the greatest achievement (30% mentioned this) doing more learning at less cost was considered to be important to 26% of respondents.

### 6.4.3 The effectiveness of distance learning initiatives

Distance learning is only one part of e-Learning but is of interest when examining measures and factors that affect the effectiveness of e-Learning. Burgess and Russell (2003) reviewed the effectiveness of distance learning initiatives in organisations that were mainly USA based. They argued that despite the fact that distance learning methods are used to train and develop employees little research has been done into their effectiveness. They also pointed out that no distinction is made between distance learning and the broader concept of e-Learning. For example, it is acknowledged that e-Learning can take place on-site in a self-paced fashion. Their review presented current literature in terms of employees' reactions, learning, behaviour, and organisational results. The focus was on distance learning programmes rather than distance education. They concluded that distance learning methods will not replace all traditional methods and a blended learning approach is recommended. They warned that return on investment (ROI) calculations should only be made with programmes of some duration, that involve a number of employees, and involve a relatively large monetary outlay. They cautioned that it is important to document the long-term

effectiveness of distance learning initiatives on employees' skills. They are therefore arguing for some longitudinal surveys to be carried out within organisations. They concluded that despite the limited amount of empirical research on the effectiveness of distance learning programmes they are still being adopted within organisations.

### 6.4.4 Literature review of evidence on e-Learning in the workplace

Lain and Aston's (2004) UK review for the Institute of Employment Studies focused on the use and demand for e-Learning as well as on its effectiveness and impact. Their main conclusions with regard to effectiveness were addressed under four headings (Kirkpatrick, 1998): (1) trainees reactions - where they found that e-Learning was effective when the trainee had a positive first experience, quality materials and support were available, and the trainee had a personal rationale for doing the course; (2) learning outcomes – they concluded that e-Learning is more effective than ordinary classroom instruction and that individuals with high computer confidence were better suited to e-Learning; (3) behavioural change – they noted that there was a limited amount of evidence about the application of what has been learnt through e-Learning; (4) organisational results – they were careful about coming to any strong conclusions about the cost savings of e-Learning. They stated that there was anecdotal evidence to suggest that cost savings are possible but concur with Welsh, Wanberg, Brown & Simmering (2003) that savings could be made, in particular, if there were lots of dispersed employees and the training was re-used. They suggested that for future research, there is a need for 'independent, statistically reliable research on the use of e-Learning in organisations' (Lain and Aston, 2004 p 34).

### 6.4.5 Research into the use of ICT and e-Learning for work-based learning in the skills sector

A 2005 Becta report described work-based e-Learning from a predominantly UK perspective. It suggested that the potential for e-Learning to make a positive contribution to work-based learning has been recognised. However they found '…little literature summarising the use of work-based e-Learning and its impact other than that reported in the corporate sector, but … did identify a great deal of reporting of individual work-based e-Learning projects' (p 5). They identified barriers to work-based e-Learning, including;

- Need for employers to be aware and engaged with e-Learning
- Need to engage employees, the availability and access to ICT
- Lack of ICT skills
- Lack of skills and knowledge to implement e-Learning

They also concluded that successful work-based e-Learning entailed;

- Provision of tutor support
- Increased integration of e-Learning with traditional forms of learning
- Focusing on the learning rather than the technological aspects

Becta emphasised that the lack of objective published evidence relating to the effectiveness of work-based e-Learning, outside the corporate sector, was surprising.

### *6.4.6 Summary of other reviews*

The evidence of the effectiveness of e-Learning in the workplace is mixed. The main result of embedding of e-Learning in large UK companies was changing attitudes. It was found that learners' reactions to e-Learning were positive when

* They has a positive first experience of e-Learning
* Quality materials and support were available
* There was a personal rationale for doing the course

In terms of learning outcomes it was found that

* e-Learning is more effective than ordinary classroom instruction
* Individuals with high computer confidence were better suited to e-Learning

In the USA it was found that although distance learning methods are used to train and develop employees little research has been done into their effectiveness. It was concluded that distance learning methods will not replace all traditional methods and a blended learning approach is recommended. It was also observed that despite the limited amount of empirical research on the effectiveness of distance learning programmes they are still being adopted within organisations.

## *6.5 What are the learners' reactions to e-Learning?*

In this section we look at the reaction of learners to their learning experience. What did they think about e-Learning? Were they satisfied with their learning experience? What did they think about the process? Did they complete their training/course? This raises the initial question of motivation and then further questions about user consultation, computer experience and other variables such as age and gender.

### 6.5.1 Motivation: the question of control

The term motivation is used infrequently within the work-based literature. However a number of synonyms for motivation are used. These include; self-efficacy, perceived control (linked to the theory of planned behaviour TPB), innovation, attitudes, job satisfaction and subjective norms.

Self efficacy, according to Potosky (2002) is 'the belief in one's capabilities to mobilize the motivation, cognitive resources, and courses of action needed to meet given situational demands' (p 242). Potosky (2002) relates self-efficacy to self-rated computer knowledge and performance during training and shows that these factors are significantly, positively related to post training SQL programming task-specific self-efficacy (SSE).

The term self-efficacy can also be used interchangeably with perceived control (an individual's appraisal of how easy something is to achieve), a term from the theory of planned behavior (TPB). Workman (2005) carried out a survey of network engineers (n = 209), using TBP to make predictions about the use of expert decision support systems. Attitudes (dispositional factors featuring positive or negative evaluations of performing a particular behavior), subjective norms (an individuals' assessment of social influences from important others), and perceived control (an individual's appraisal of how easy something is to achieve) were taken in to account while looking at the usage of the system. It was suggested that more negative attitudes and greater

subjective norms (social influence) would be related to increased system misuse. It was found when attitudes are poor and subjective norms are high then there is a non-linear tendency to misuse the technology. This means that engineers using the system were likely to pretend to use the technology but ignore or misuse its 'output' and this misuse could be attributed to social influence. Workman suggests that strong subjective norms (social influence) are more likely to affect *how people use a technology rather than whether they actually use the technology*. It is also suggested that these findings are related to trust in the system. This study raises the issue of motivation linked to individual characteristics (the appraisal of how easy it is to do something) and social influence (how people who are important to the individual can affect their behaviour). Another study using the theory of planned behaviour (Luarn & Lin, 2005) explored the 'behavioral intentions' of individuals (n = 180) to use mobile banking. This paper addressed issues of attitudes to technology.

Again perceived control and self-efficacy is implicit in Olsson & Jansson's (2005) small scale qualitative study of a participatory design process involving train drivers (n = 6). They found that in order for users and designers to communicate effectively and create a design there needs to be: (1) mutual respect – where users are taken seriously and feel that their knowledge counts (2) active participation on equal terms – it is useful to let users outnumber designers (3) a common goal – both users and designers share common goal of design of future interface (4) common language – where in-depth discussion lead to common domain language (5) attention – designer must listen carefully to the users' narratives. This approach is supportive of the worker/learner.

Support for the learner or trainee is an important factor in increasing motivation and decreasing frustration. Newton, Hase, & Ellis (2002) in a study of mining personnel (n = 32) point to factors that are important for the effective implementation of online learning in the mining industry. They expressed a concern about the need to encourage learner awareness and motivation to participate in online learning. Doubts were raised from their review where workers expressed a preference for 'classroom-based learning' based on their previous experience of learning. Newton et al. state that online training programmes need to be easy to access and navigate to minimise user frustration. Assessing a learner's needs and supporting those needs are also important. Svensson & Ellstrom, (2004) also believe that there needs to be a supportive structure if workplace learning with elements of e-Learning is to function successfully. They claimed that their case studies (n = 186) supported this assumption.

The notion of control and specifically self-efficacy and perceived control as assessed by a survey/questionnaire is a measure that features strongly in the literature. These are measures that have intimate links with motivation. Some of the findings need to be accepted with some caution as often the purported measure i.e. perceived control is assessed through a partial questionnaire (items taken from the full questionnaire) with very few items (statements) for the participants to respond to. This cannot always be accepted as a measure of perceived control, as any construct validity that the research tool had is diluted by the use of fewer items.

It is worthwhile introducing a note of caution into the discussion of the empowering nature of e-Learning. Macpherson, Homan & Wilkinson (2005) described case studies of three corporate universities. They suggested that e-Learning is no more likely to motivate the person who doesn't want to learn than any other form of learning, and therefore the problem of motivation remains. They further argue that the lack of the assessment of the learners' experience is a problem: 'the learner's voice is almost silent in the assessment of e-Learning' (p 45), and that the culture of the company may play a significant part in the acceptance, or not, of e-Learning. The learner's voice is of course important and is not discussed extensively in the work-based e-Learning literature. Therefore it is useful to explore the notion of user consultation as a more indirect measure of the learner's voice.

### 6.5.2 User consultation: understanding the learning needs and capabilities of the learner

The literature on user consultation covers a wide range. The term usability did not feature in the higher education review but is referred to in the WBL literature. It can be defined as an evaluation and measurement of a computer program's overall ease-of-use. In this sense usability can be seen both as an outcome and as a process. For example, outcome measures are used by Calisir & Calisir (2004) who look at the relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end-user satisfaction with enterprise resource planning systems. They use a usability characteristics survey to assess end-users' satisfaction (n = 51) and focus on the practical aspects of a system already in place. This type of study does not really address users' needs in the same way as user consultation, where users are consulted while the design of the system is being undertaken. Olsson & Jansson (2005) report on a participatory design with train drivers. They suggest that participatory design creates an efficient learning process where decisions are backtracked and revised. In order for users and designers to communicate effectively and create a design they suggest that there needs to be:

- Mutual respect – where users are taken seriously and feel that their knowledge counts
- Active participation on equal terms – it is useful to let users outnumber designers
- Common goals – both users and designers share common goal of design of future interface
- Common language – in depth discussion will lead to common domain language
- Two way communication – designer must listen carefully to the users' narratives
- Reflective design - refrain from immediate implementation thinking – designers need to avoid thinking about solutions immediately. The discussion of technical constraints may distract from more important implementation issues.
- Simple tools that reveal what the work is about – simple sketching tools work best

These points have been raised before in a previous section but warrant another mention. Olsson & Jansson (2005) argue that although usability activities are used in IT development they are not used enough. They suggest that to produce usable systems, time and effort needs to be put into acquiring knowledge of the work domain and developing a common ground in terms of shared knowledge and improved understanding of the work context between those involved in the system development. 'Prototypes are efficient for gathering and visualizing functional requirements, and they can act as tools for learning about and negotiating requirements' (p 162).

An interview approach was used by Dobson, Pengelly, Sime, Albaladejo et al. (2001) to examine users' perceptions of a team training simulation system with a virtual reality interface for learning from emergencies. They argued that team training strategies are desirable, that the use of training scenarios for constructing shared mental models with intelligent agents are valuable and that a virtual reality interface is useful. In both Dobson et al's and Olsson and Jansson's approach the emphasis is on the learner or trainee's reactions whilst working in a shared environment.

Inadequate usability measures reflect the lack of acknowledgement that users' needs should to be taken into account. Boivie, Aborg, Persson, & Lofberg, (2003) argued that occupational health problems in computer-based visual display unit work are caused by multiple, interrelated factors, some of which are poor usability and inadequate software. Their interview studies (n = 64) investigated: the view of usability and users' health, and user involvement in a software development project. Three main themes were identified: (1) Attitudes about and responsibility for usability and occupational health matters (2) user involvement, cooperation and communication between development team and the users (3) the software development process. They found that:

- On the individual level, the attitudes of the developers can be both helpful and obstructive in creating a development process with a focus on usability and occupational health issues. Few software developers had sufficient skills and expertise in usability and occupational health matters and occupational health experts were not involved at all.
- At the project level, the software development process must support a usability focus, there must be firm commitment to usability, and design decisions need to be made by everyone involved in the project.
- At the organisational level, unclear responsibility for usability and health issues can be an obstacle, decision making outside the project (e.g. by IT strategy group and upper management) with no concern for usability, deadlines can create time pressures that prevent developers thinking about anything else but the functionality, some usability and effects on the health of the users can only be evaluated over time, and software development is often conducted in isolation from the organisational development.

User consultation, however, is not always the whole answer. As Boivie et al. (2003) point out, there is often little or no dedicated design regarding usability matters, and user participation does not always guarantee usability.

### 6.5.3 Why Flexibility is Important

In a review of work-based e-Learning it might be expected that the main measure of the effectiveness of e-Learning would be cost. But it has been shown in the literature that flexibility if a key issue. There needs to be an acceptance of the technology and this is often facilitated though the flexibility of the introduction of the technology, the flexibility of the usage of the technology (this includes time factors), and the flexibility of the organisation in its expectations and support of employees when e-Learning (sometimes training) is introduced. It can be seen that flexibility is intimately linked to motivation, user consultation, the facilitation of learning, the level of experience of the user, and costs if the implementation of e-Learning in an organisation is a success.

Flexibility can mean the extent to which e-Learning allows people to learn at their own pace and in their own time. This essentially means the flexibility of the system. However in work-based learning there is less emphasis on people learning in their own time. McDonald (2001) argues that effective and flexible learning systems enable employees to adapt more easily to change and that this increases their effectiveness. He suggests that multimedia systems can enhance performance by accelerating learning. However the findings from his study of Holiday Inn employees (n = 826) did not demonstrate that using multimedia improved employee's attitudes to learning. There are obviously other factors involved here in addition to the flexibility of the system which will be discussed in later sections.

Sambrook (2003) in a two year research project explored 'the pedagogical quality of electronic learning materials designed to stimulate lifelong learning, and specifically learning relevant to business' (p 511). Employer perspectives were gathered through an evening workshop and a telephone survey of 146 SMEs. Employee perspectives were gathered from 159 individuals who were existing SME employees, recent graduates, or trainees engaged in training and seeking employment. From the employers' perspective, lack of time and resources was seen as an inhibiting factor when using e-Learning. This can be interpreted as kind of lack of flexibility due to a perceived lack of time and resources available. The difficulty in identifying the full cost of computer based learning was also mentioned. During the telephone survey it appeared that very few employers (12%) were using computer-based learning but a further 28% declared a willingness to join the 'technological learning revolution'. From the employees' perspective the most important factor identified was whether the computer-based learning was user-friendly. Sambrook argues that innovations in information and communication technologies could create new forms of learning in small organisations that could potentially overcome barriers such as financial resources, time, expertise, and facilities. This implies a certain amount of flexibility on the part of both the employer and the employee. However there is also the question of computer experience and computer anxiety which can also affect the adoption of new technologies.

### 6.5.4 Barriers to e-Learning: Computer experience and computer anxiety

The importance of computer experience is highlighted in a number of papers. Ford & Murpy (2002) claimed that an organisation must be able to assess the IT skills required by their workforce to enable them to use computer based training effectively. They also argued that completion of training needs to be tied in to a professional development scheme. Computer experience was also discussed in relation to the size of an organisation. Kekeale, Pirolt, & Falter (2002) stated that their results suggest that most small companies are not yet ready to use the latest IT technologies in their personnel training. Furthermore new IT solutions rarely produce what they promise for small companies. It seems that not many of the IT solutions are developed with small companies in mind. They suggested that to enable small companies to take advantage of IT solutions there needs to be (1) more effective system of dissemination of best practices organized either by training providers or by local national policy actors (2) work towards raising the general IT literacy level among adults especially among the SME workforce.

A number of issues linked to computer experience as a barrier to use were raised by Rhodes & Carter (2003) when they described a project that aimed to develop collaborative learning amongst networks of suppliers and to extend accreditation achieved in the workplace. The focus of the research was on the automotive sector. There were 4 project objectives (1) the clarification of organisational and inter-organisational learning needs (2) identification and utilisation of distance learning technologies matched to SMEs learning needs (3) support for SMEs to expand their innovative capabilities (4) investigation of ways that ICTs might support an inter-company context. The main question was: 'How could practical engineering-centred workshops be integrated with computer-based activity and reflective learning?' (p 277). A number of factors that were mentioned:

- Unfamiliarity with the web – good quality web based materials underutilised
- Platform diversity – the First Class system did not integrate with systems that companies already had in place
- Innovatory applications – screen display and voice link conferencing application proved to be 'insufficiently robust' in a commercial context
- Firewall protection – in some larger companies it was necessary to provide machines outside the company firewalls in order for there to be access to the project facilities (e.g. web based resources) and this proved to be a problem.

Computer anxiety is related to computer experience as it is often user involvement and training that alleviates computer anxiety. Mikkelsen, Øgaard, Lindø, & Olsen (2002) examined job characteristics and computer anxiety in the production industry (n = 336). The purpose was to explore the antecedents of computer anxiety, there defined as 'fear about working with a computer or thinking about working with a computer' (p 224). The results showed that gender, age, education, and job characteristics, and training were the most important indicators of computer anxiety. Job demands did not relate significantly to computer anxiety and managers had significantly less computer anxiety than non-managers. Female employees reported significantly higher computer anxiety than males. Mikkelson et al. found no relationship between active coping style

and computer anxiety. Solutions to the computer anxiety problem seem to be user involvement, training and a work design that permits sufficient interpersonal relationships and social support.

The term internet anxiety was used by Zhang (2005) when he explored telecommunication employees' (n = 680) use of the internet in the business world. The data was collected through a local telecommunications enterprise intranet. It was found that employees used the internet either as a communication tool or as a resource for information. Female employees viewed the internet to be equally as important as male employees did. The younger and the more educated that the respondents were the more useful they felt the internet to be. Females were found to 'develop' more anxiety than males and younger and more educated employees felt less stress when they used the internet. Zhang suggested that training should be provided for female employees to alleviate stress and older colleagues should be helped to become more comfortable with the technology.

**6.5.6 Summary of studies, comparisons with previous reviews and recommendations for future work**

Learners' reactions to their learning experiences have been measured mainly through questionnaires. The consensus so far is that those individuals who have **computer experience** are more confident when performing specific tasks in e-Learning. To a certain extent the findings from these studies are intuitive in relation to **motivation** and **self-efficacy**. However there are other influences on a learner's reaction to e-Learning. The appraisal of **how easy something is to do** is linked to the influence of others in terms of the perceived importance of that technology. A supportive environment where learners' needs are taken seriously can both increase motivation and decrease **frustration**. When the learner's voice is heard this leads to an increase in **perceived control**. Evidence from participatory studies showed that mutual respect between designers and users of e-Learning, participation with shared goals and shared language, and listening to the users can lead to effective communication and consequently effective e-Learning. However the involvement of users does not always guarantee that all the tools will be used. **Acceptance of new technology** can be thwarted in many ways. Sometimes it can be lack of computer experience but **computer anxiety** can also play a part.

The 'reactions of the employees' is often the only level of evaluation of e-Learning that takes place within work-based learning. We would recommend that more research is undertaken that includes

* Longitudinal studies
* Qualitative studies that look at the trainee's experience in depth. These should include observational studies
* More studies that look at computer anxiety. Both this review and previous reviews have identified factors that can contribute to anxiety.

## *6.6 What is the quality of the learning?*

In this section we look at the quality of the learning experience And gthe factors that influence it.

### 6.6.1 Learning styles and preferences

We did not find as many work-based e-Learning papers that referred to learning styles and preferences as in the higher education literature. Learning preferences are mentioned by Tao, Ho & Yeh (2001) who reported on a project to build an executive learning system (ELS) by examining 'the relationships between the learning preference and content selection of business executives, and their computer usage, leadership style and content awareness level' (p 317). What this means is that ELSs supports learning rather than decision-making therefore issues such as instructional methods, learning content selections, and learning preferences need to be addressed. This is in contrast to executive information systems (EIS) and executive support systems (ESS) where decision making is dominant. The focus of this study was on learning for business executives (n = 63). The main results indicated that leadership style had a strong influence on learning style. Leadership style was categorised as autocratic and democratic. By contrast, learning style was categorised as experiential, case guided, and analytical.

Learning preferences are also mentioned by Macpherson, Homan, & Wilkinson, (2005) who argue that if corporate universities do not incorporate both the pedagogical and learner preferences perspectives into their use of e-Learning, this will seriously devalue the training experience. This is an example of where the notion of learning styles or preferences is accepted uncritically. They conclude that the advantages of an online pedagogy are not fully exploited due to limitations in technology and other strategic priorities. They point out that the drive for efficiency sometimes stand in the way of the adoption and inclusion of the full range of technical possibilities. and the lack of the assessment of the learners' experience is a problem 'the learner's voice is almost silent in the assessment of e-Learning' (p 45).

### 6.6.2 Literacy levels

Learning styles need to be accepted, as a factor that influences the effectiveness of e-Learning, with some caution. But literacy levels are an important variable within work-based learning as they can possibly influence the effective use of a system. This does not mean, however, that lower literacy levels will always have an adverse affect on e-Learning. Coleman, Rea, Hall, Sawyer, & Hemsworth, (2001) investigated the effectiveness of a multimedia training program designed for use by stockpeople (n = 92) in the pig industry. This was a comparative study with the information being presented in either multimedia or manual format with and without the presence of a tutor (i.e. four training conditions). The participants took part in the training session on 'Human factors in pig productivity' and then completed knowledge and satisfaction questionnaires and a literacy test. Six weeks after the session the knowledge questionnaire was administered again to test retention. There were no significant differences between the 4 groups on the literacy test score or for length of employment. Scores on the knowledge test decreased over time.

Overall, there was no support for the hypothesis that the multimedia participants would perform and retain content better than manual condition participants. The presence of a trainer had a negative effect on recall of information for both the multimedia and the manual condition. However participants in the multimedia group were more satisfied with their media than the manual group. One interesting finding was that there was a positive relationship between the literacy test and the change (deterioration) of knowledge score over time (six weeks) but only in the multimedia group. This means that those who showed a greater loss of knowledge over time were those with the higher literacy scores. 'Multimedia presentations may be differentially beneficial to less literate people, even in a group with low overall formal education' (p 268).

Newton, Hase, & Ellis (2002) also voiced concern for the learners' needs stating that adequate literacy was essential but was varied within the mining industry. 'The reported low reading literacy levels in the mining industry could have an important impact on the design of learning materials' (p 162). There were concerns that workers at the lower levels might not have the motivation to learn unsupervised, online. They raised doubts based on their literature review that workers expressed a preference for 'classroom-based learning' based on their previous experience of learning rather than an understanding of what online learning entails.

### 6.6.3 Learning and flexibility

A supportive, flexible structure for e-Learning within an organisation is important. Svensson & Ellstrom, (2004) suggested that learning should be accessible to the company and employees, learning should be of practical use, individual work plans and study supervision is essential, local study centres enable decentralization, and there needs to be flexibility and response to demands. Out of this list, they suggest that the most important factors are accessibility and flexibility. Svensson & Ellstrom concluded that there needs to be a supportive structure if workplace learning with elements of e-Learning is to function successfully. They claim that their case studies supported this assumption. This study is also related to the issue of literacy levels that has been raised in the previous section (Coleman et al. 2002; Newton et al. 2001)

Ford and Murphy (2002) also addressed the subject of learning and flexibility. In a study of the development of a website for local authority and safety enforcement officers (n = 12) they found that in relation to flexibility, online training can provide opportunity for learners to adopt different learning strategies. The layering of material can accommodate a range of abilities and prior knowledge. They further argued that engaging learners through interaction with the medium can support deep learning and that familiarity with the internet will enable those users to exploit interactive features.

The exploitation of interactive feature shows another dimension of flexibility and that is the flexibility of the learner in the learning environment. Pototsky (2002) discussed computer playfulness which refers to an individual's tendency to interact spontaneously, inventively, and imaginatively with computers. This is a type of

flexibility of the learner. Pototsky (2002) found that there was an interaction between computer playfulness and performance during training (in SQL) where computer playful individuals who performed well during training made higher (more positive) post-training SQL efficacy judgments. This means that computer playfulness which can be seen as an individual measure of flexibility is related to better performance and higher ratings of ones own abilities (self-efficacy). She suggested that organisations could encourage playfulness during training in order to stimulate exploration during practice activities.

#### 6.6.4 Summary of studies, comparison with previous reviews and recommendations for future work

Workplace learning is conceptualised differently than in higher education. There is a tension in the literature on work-based e-Learning between the need to take account of individual differences, such as literacy levels, and accepting that the use of learning styles is not always the answer. There is evidence that **flexibility** leads to learners adopting different learning strategies and leads to better learning outcomes.

The gaps in the literature lead us to recommend that more research is undertaken that includes

* The interaction between literacy levels and engagement and success with e-Learning. This needs to be explored in more detail
* Studies that use different levels of flexibility in the system. 'Computer playfulness', the employees belief in their own abilities, and performance could be explored

## *6.7 Does work based e-Learning alter the behaviour of the learner?*

In this section the evidence for whether work-based e-Learning changes the behaviour or performance of the learner is examined.

### 6.7.1 Interaction and collaboration

Monitoring interaction with and through technology is one way of assessing any change in the behaviour of the learner. The importance of assessing learners' skills is linked to the engagement of the workforce. Ford & Murphy (2002) argued that engaging learners through interaction with the medium can support deep learning and that familiarity with the internet will enable those users to exploit interactive features. They claimed that employers must be able to assess the IT skills required by their workforce to enable them to use computer based training effectively. In their study they found that the trainees (n = 44) who were testing their system were reluctant to use the discussion forum and peer review features. Ford and Murphy described this is as an important finding that needed to be explored as it indicates a need for support in the use of these specific tools.

Interactions using virtual reality are one of the ways that e-Learning can potentially change behaviour. When simulations are used to support reflective learning and planning these can lead to regulation or revision of a prospective course of action. Dobson et al. (2001) described a team training simulation system with a virtual reality

interface for learning from emergencies. They described how the simulation interface appeared to team members, how agents are integrated and how shared mental models are the intended outcomes. Here they are suggesting that using simulations alters the behaviour of the learners in emergencies.

Behaviour in terms of collaboration and communication combined with user consultation on a larger scale was investigated by Russell, Calvey, & Banks (2003) who explored how small and medium sized firms (20 UK companies) that produced e-Learning materials collaborated and communicated with their clients, external agencies and end users. They visualised the steps as (1) the sourcing of the content from the client (2) the increasing need to draw advice from external 'learning experts' (3) the involvement or conceptualisation of the end user in the development process. Russell et al. raised the issue of 'how firms can effectively interact and collaborate with others in order to create, distribute and evolve effective e-Learning products' (p 34). They proposed that there are 3 interlinked issues for businesses in the e-Learning field: learning about learning, acquiring subject knowledge, and learning to become part of a wider community. They argued that these issues cannot be conceptualised through the communities of practice but need to be extended to 'learning communities'. By this they mean that the creation of e-Learning products requires 'new convergences of technology, media, skills, and, increasingly, individuals and organisations themselves' (p 42). This point is related to the diffusion of innovations model where the innovation (e-Learning) is driven by both the nature of the idea or technology and also by the social system in which it is situated i.e. the context.

### 6.7.2 Communication: Multiple conversations

Instant messaging (IM) is an interesting example of the flexible use of technology in organisations which can lead to a change in behaviour. Cameron and Webster (2005) suggested that with increased global connectivity 'organisations may adopt emerging technologies such as Instant Messaging (IM) in order to increase collaboration at a distance and to decrease communications costs' (p 85). IM is a technology that allows users to set up a list of partners who will be able to receive notes that pop in their screens the moment that one of them writes and hits the button. 'Symbolic cues' is a term used in this context to mean the cues conveyed by the medium itself, above and beyond the literal message. This has implicit links to flexibility both in the technology itself and how it is used - people within an organisation can use the medium in a number of subtle and effective ways. An example of this is polychronicity which means (1) sending multiple forms of communication e.g. verbal and text (2) when a person is using one medium to communicate with one person and another to communicate with another e.g. talking on the telephone with one person and in IM conversation with another person (3) queue jumping where a person is using one medium and second person attempts to initiate a conversation using a second medium. Cameron and Webster found, using interviews with 19 employees, that the explanations for using IM included: critical mass (if more people used, I would use it), symbolic cues (IM suggests an informal tone), and media richness (the main dimension was for quick responses and instant feedback). The key issue here is

the flexibility of the system and the choice on the part of the employee to engage in this informal communication behaviour.

### 6.7.3 Summary of studies, comparison with previous reviews and recommendations for future work

There is not as much evidence for change in behaviour as a result of e-Learning as for the other two previous levels of evaluation. What evidence there is suggests that **engaging** learners through **interaction** with the medium can support deep learning and that changes in behaviour also occur through, for example, the use of Instant Messaging (alongside other technologies) to carry out **multiple 'conversations'**.

## *6.8 What is the impact of e-Learning on the company or organisation?*

In this section the impact of e-Learning on the organisation is examined. What are the organisational effects resulting from the trainee's or learner's performance? These issues are generally related to cost savings in the work-based e-Learning literature.

### 6.8.1 Flexibility and innovation

The diffusion of new technologies or innovations in organisations can be helped or hindered by the nature or attributes of particular innovations (Rogers, 2003). Kekeale, Pirolt, & Falter, (2002) investigated some of the impediments that hinder or slow the diffusion of new IT technologies in personnel training in small companies. They interviewed 120 specialists from four companies and concluded that one of the ways to improve the diffusion of IT in personnel training in small and medium enterprises is to improve the flexibility of the training '*real* freedom of time, space and pre-described content' (p 275). This type of flexibility is intimately linked to costs and this is also acknowledged by Newton, Hase, & Ellis (2002) when they suggest that online learning could be measured by cost effectiveness, increased return on investment, and whether it met training needs. An example of this is where management has strategically aligned online learning with a corporate goal or problem e.g. when increased flexibility is provided by online just-in-time training. The attribute of e-Learning (the innovation) in this sense is the relative advantage that online learning provides in terms of perhaps economics, convenience and satisfaction.

Some researchers argue that the indiscriminate introduction of a system into an organisation can create inflexibility. These notions have a direct relation to the diffusion of innovations literature where the attributes of an innovation (e.g trialability, observability) need to be taken into account. Hennessey & Sawchuk (2003) reported findings from a study on the changing nature of work, learning and technology in the Canadian public sector (n = 80). They described a business transformation project which resulted in an automated eligibility review process for welfare and disability clients. This new IT system was implemented in 200 sites across Ontario, Canada. The results indicated that workers were critical of this form of organised learning arguing that informal learning among peers is the foundation of the learning process. Hennessey and Sawchuk (2003) suggested that 'Virtually every interviewee notes that they work and learn under a labour process that has been transformed from a humanised, holistic and semi-professional one to one that is

depersonalised, polarised in terms of labour management relations, fragmented and de-skilled' (p 321). These findings need to be accepted with caution as it is not clear how the data was gathered from the 80 interviewees. Nevertheless there are some important points made in terms of the new system being too inflexible to respond to the unpredictability of clients' needs. One theme emerging from the introduction of the automated system was the expansion of informal co-worker learning networks. The authors argue that their findings reveal the potential for user-based technological development. Here it is the lack of understanding of the existing values, norms and needs of the potential adopters that produce an incompatibility.

The existing norms and needs of an organisation can also lead to tools being under-utilised when they are made available. Lahn, (2004) investigated how a learning arena that promotes 'just in time' learning in the workplace could be created. One of the most important aims of the project was to develop interactive tools to aid in the construction of a tool for net-based learning in the workplace. Although, according to Lahn, (2004) the users (n = 170) were positive about the net-based arena they seldom used the interactive dialogue tool. It was suggested that was because it is not easy to build new communities of practice i.e. lack of use of dialogue tool, and the dialogue tool was poorly adapted to the culture of the organisation (the visual work culture of the graphics industry).

It needs to be acknowledged that flexibility is often used in conjunction with cost. For example, Macpherson, Homan, & Wilkinson, (2005) in their discussion of the implementation and use of e-Learning in the corporate university pointed out that that the advantages of e-Learning stated within the literature are cost, the flexibility in delivery and the pace and distribution of learning. They argued that the advantages of an online pedagogy are not fully exploited due to limitations in technology and other strategic priorities. In addition, a number of lessons have been learned by the pioneers of corporate e-Learning, including the evolutionary nature of the programmes and the need to create 'organisational readiness' (p 33) Macpherson et al. pointed out that the drive for efficiency sometimes stands in the way of the adoption and inclusion of the full range of technical possibilities, and the lack of the assessment of the learners' experience is a problem 'the learner's voice is almost silent in the assessment of e-Learning' (p 45), and the culture of the company may play a significant part in the acceptance (or not) of e-Learning. This notion of the culture of the company playing a role in the acceptance of e-Learning is also linked to one of the proposed attributes of an innovation – compatibility. This means that there has to be a measure of the consistency of e-Learning with existing values, norms, past experiences, and the needs of potential adopters.

Perceived control or self-efficacy is implicit in the discussion of the 'artifacts' used in technological and organisational change, in two case studies by Masino & Zamarian (2003). By artifacts they mean something more sophisticated than a tool and define them as 'negotiated, embedded, and sedimented sets of rules for goal oriented action' (p 694). In this sense the artifacts and their use bear a relation to motivation. It is suggested that artifacts can be seen as a visible translation of the knowledge developed

within and outside organisations. In one case study carried out by Masino & Zamarian the problem of uniformity in car rental practices was described. The artifact in this context (software that allows maximum attention to be focused on the customer) was seen as having dual a nature (1) it was a receptacle of previously gathered experience and a means to distribute the experience among other shops of the company (2) it was also a mediator between the rules imposed by the managers and the actual work practice of the operators themselves. In another case study control effectiveness and implicit negotiation in computer aided design (CAD) was described. The context was the use of CAD, where different types of draftsmen's knowledge skills became relevant to the process. Masino and Zamarian argued that this change process is an implicit negotiation between the artifact's adopters (the managers of the firm) and the users (the draftsmen) where the draftsmen experienced a positive change in their work conditions. They made an important distinction between artifacts as outcomes – 'the vessels carrying the rules influencing users' behavior' (p 693) or as inputs – the devices through which new rules are generated or existing ones are changed. The negotiation and positive change in work conditions through the artifact can be seen as perceived control. Again the diffusion of innovation literature is relevant here where the trialability and observability of the CAD created a positive environment where the innovation was accepted.

### 6.8.2 Costs

Cost as a measure of the effectiveness of e-Learning in organisations is of course a key issue. However as has already been observed some companies implement e-Learning on a zero budget so that cuts have to be made elsewhere (Macpherson et al., 2005). Productivity is inevitably linked to costs as it indicates a return on investment (ROI). Profitability and productivity are alluded to in the literature but not discussed in any great depth. For instance, Mikkelsen et al. (2002) reported on a study that was aimed at developing and implementing computer technology in order to improve profitability, employee well being, and work environment. Interestingly, there was very little reference to the profitability aspect in the paper and the main focus was on computer anxiety.

The reduction of the costs of training can be seen as an organisational benefit. Newton et al. (2002) in the discussion of the training environment acknowledged that reducing costs and providing relevant content were seen as important. They argued that trainers need to provide a safe learning environment that takes into account the learner's motivation and cost of failure (admitting that they don't know). Here they move from cost to the organisation to the cost to the individual who is taking part in the learning. These points have been visited a few times in this report in different guises. There are echoes of the issues of self-efficacy, perceived control, computer experience, user consultation and computer anxiety.

Another issue that is addressed is the difficulty in assessing how much e-Learning will cost an organisation. Sambrook (2003) in a study of SMEs found that from the employers' perspective, lack of time and resources was seen as an inhibiting factor in the adoption of e-Learning. The difficulty in identifying the full cost of computer

based learning was also mentioned. In addition to the difficulty in assessing how much e-Learning costs, for some organisations (and perhaps this is relevant to the sector - see Hills and Kappler's review, 2004) there is also an unwillingness to incorporate e-Learning into their business practices.

An example of unwillingness to incorporate e-Learning into to business practice is an study of the usage of the internet and the perception of online learning in small and medium sized hotels in Austria, Ireland, Great Britain and Switzerland (Collins, Buhalis & Peters, 2003). A questionnaire was sent to 250 hotels in the four countries and 55 questionnaires were completed (22% response rate). Limitations that were acknowledged in this survey included the hoteliers' response to the 'academic' research which was seen as having little relevance in helping them understand e-Learning. The majority of respondents (93%) used the internet as a mechanism to promote the hotel. Hotels did not use the internet for inter and intra-organisational purposes. The perceived barriers to using the internet were the complexity of trying to navigate websites, download time, the design of websites and too little information being available. The majority of hotels used the internet as a digital brochure and any interactivity was primarily through email. High staff turnover was a feature of the industry and could be helped with in-house training for staff. However it was managers who attend professional training sessions. It is argued that hotels' participation in online training would benefit them and could also be cost-effective. Most respondents saw time-independence as the main advantage of online learning, and the lack of interpersonal contact with other users, and support and feedback from module coordinators as the main disadvantage. Other disadvantages were lack of industry or best-practice examples and the lack of a recognized qualification or accreditation. The barriers to hotels investing in ICT are the lack of financial resources, time, and the unwillingness to invest in training.

### 6.8.3 Diffusion of Innovations

When the organisational effects of e-Learning resulting from the trainee/learners performance are examined a number of factors need to be taken into account. It has been proposed that the diffusion of innovation model is a useful aid in enabling us to understand what is happening in organisations when e-Learning is introduced. An innovation as defined by Rogers (2003) is 'an idea, practice, or object perceived as new by an individual or other unit of adoption' (p 36). It is the qualities of an innovation, as perceived by members of a social system or group, which determine the rate of adoption. So innovation is driven both by the nature of the idea or technology and also by the social system in which it is situated i.e. the context.

We have addressed the issue of organisational impact by incorporating the diffusion of innovations model into our review. The adoption and evaluation of e-Learning by organisations is also relevant at the societal level and dissemination of evidence is essential. The attributes of an innovation such as e-Learning can be judged based on its

- Relative advantage - is it better than what was available before?
- Compatibility - does it fit with the organisational culture?
- Complexity – is it difficult to understand?

- Trialability - can it be tried out without taking it on in its entirety?
- Observability - can we see that it is better? Can it be seen to work?

A culture that supports new ways of delivering learning is essential and requires commitment and leadership at senior level (Birchall and Woolfall, 2003). This is related to both the compatibility of the innovation (it fits in with the organisational culture) and the observability of the innovation (it is seen to work). Macpherson et al. (2005) support this point and suggest that the culture of a company can play a role in the acceptance (or not) of e-Learning. Flexibility is important and has been highlighted throughout this review. It is linked to innovation in terms of the relative advantage of e-Learning (is it better than what was available before?) For example, Newton et al. (2002) point to the increased flexibility in learning that online just-in-time training can deliver. The other side of the coin, inflexibility, is an issue that is related to both trialability (can it be tried out without taking it on in its entirety?) and also observability (can we see that it is better?). The indiscriminate introduction of a system in to an organisation can fail to respond to the unpredictability of clients (Hennessey and Sawchuk, 2003). Here the system was introduced in its entirety and the users could see that it did not work in the way they needed it to. Negotiation and positive change in work conditions were highlighted by Masino and Zamarian (2003) as elements of the introduction of e-Learning that were essential to the success of the innovation. This is related to both the trialability and the observability of the innovation.

**6.8.4 Summary of studies, comparison with previous reviews and recommendations for future work**

**Flexibility** is a factor that features far more extensively in the work-based learning literature than in that of higher education or medical education. Flexibility can be seen as a measure of the individual or of the organisation. An **acceptance of the technology** is often facilitated though the flexibility of the introduction of the technology, the flexibility of the usage of the technology (this includes **time factors**), and the flexibility of the organisation in its expectations and support of employees when e-Learning (sometimes training) is introduced. It can be seen that flexibility is intimately linked to motivation, user consultation, the facilitation of learning, the level of experience of the user, and costs if the implementation of e-Learning in an organisation is a success. **Cost** as a measure of the effectiveness of e-Learning is of course a key issue. However some companies implement e-Learning on a zero budget so that cuts have to be made elsewhere. Productivity is mentioned in the literature and is inevitably linked to costs as it indicates a return on investment (ROI). The diffusion of innovation model has been used to point to the ways that the attributes of an innovation model are already implicitly used in the work-based e-Learning literature.

The gaps in the literature lead us to recommend that more research is undertaken that include

*. Careful cost-benefit anslyses of the introduction of e-Learning in the workplace.

# 7. What works? How do we know it works? What are the factors that influence how well e-Learning works in the three sectors?

In the reviews of the evidence for the effectiveness of e-Learning in higher education, medical education, and work-based learning there is weak, positive but not yet compelling evidence of the effectiveness, so we looked for 'what works'. We found that the answer to questions of what works in e-Learning and how we know that it works were always moderated by contextual variables. Therefore the summary of what we have found is presented in a table of key factors that influence how well e-Learning works in higher education, medical education and work-based learning. The factors are organised by Kirkpatrick's (1989) levels of evaluation and the similarities and differences between the factors, that influence the success of e-Learning for undergraduates, medical professionals, and for those in work-based learning, are outlined.

## *7.1 What works?*

Situational and contextual factors will always have an influence on the success of e-Learning. But from an examination of the factors that influence how well e-Learning works we can still reach some conclusions about what works. Overwhelmingly, it is the human factor rather than the technology that matters. On the individual level:

- The confidence of individuals in their own abilities when engaging in e-Learning is crucial
- Prior knowledge at both the operational level (how to do it) and the conceptual level (understanding) is important

On the social level:

- The presence and involvement of a teacher/trainer can have an impact on how well e-Learning works
- Communication - the continuing dialogue between the teacher and the learner and also between learners is important
- Tutors, faculty members, and fellow workers can have an influence on the adoption of new technologies through role modelling and social learning

Table 7.1 Key factors that influence how well e-Learning works in the higher education, medical education and work-based learning

| **Levels of Evaluation** | **Higher Education** | **Medical Education** | **Work-Based Learning** |
|---|---|---|---|
| **The experience of the learner. What are learners' reactions to e-Learning?** | 1. Skill levels<br>2. Confidence in own abilities<br>3. Attitudes to use of technology influenced by faculty<br>4. Positive attitudes to blended learning<br>5. Perception of assessment requirements | 1. Interactivity<br>2. Flexibility<br>3. Control of the pace<br>4. Computer expertise<br>5. Ease of use<br>6. Confidence | 1. Computer experience<br>2. Confidence in own abilities (self-efficacy)<br>3. Perceived control<br>3. Ease of use<br>4. Motivation and frustration |
| **What is the quality of the learning?** | 1. Understanding of potential of the materials available<br>2. Teacher presence<br>3. Type of task<br>4. Assessment<br>5. Motivation<br>6. Voluntary engagement<br>7. Computer expertise | 1. Type of task<br>2. Type of learning environment e.g interactive media, web-based learning<br>3. Personal involvement of the tutor | 1. Literacy levels<br>2. Flexibility<br>3. Motivation |
| **Change in behaviour due to e-Learning. Does e-Learning alter the behaviour of the learner?** | 1. Collaboration<br>2. Type of social environment<br>3. Uncertainty (needing to ask questions)<br>4. Influence of computer expertise on use of technologies | 1. New technologies (e.g. PDAs) change the way information is accessed<br>2. Acceptance of new technologies influenced by observation of tutors' usage | 1. Collaboration<br>2. Interaction<br>3. Use of new technologies in communication |
| **What is the impact of e-Learning on the organisation?** | 1. Acceptance of change<br>2. Retention<br>3. Costs | 1. Acceptance of technology (change)<br>2. Flexibility<br>3. Costs<br>4. Lack of time | 1. Acceptance of technology (change)<br>2. Flexibility<br>3. Costs<br>4. Lack of time? |

## *7.2 The experience of e-Learning in higher education, medical education and work-based learning*

There are similarities across the three sectors in terms of what influences the learner or trainee's satisfaction with e-Learning. An important factor is individuals' confidence in their own abilities. This influential factor is common across all three sectors and reinforces HEFCE's (2005) view that there needs to be confident use of the full range of pedagogic opportunities provided by ICT. For undergraduates, medical students and practitioners, and people in the commercial sector the level of computer expertise can have an influence on attitudes to e-Learning. The ease of use of the technology was important for people in medical education and in work-based learning but was not a factor that featured as extensively in higher education. Students in higher education have positive attitudes to blended learning and their attitudes were influenced by faculty use of technology. Research on the attitudes of medical students and practitioners to blended learning showed that the emphasis was on flexibility and control of the pace of learning. Control of the learning experience was also a factor that featured in work-based learning. An understanding of what is required in a particular learning environment can influence the experience of e-Learning. For undergraduates this can mean their understanding of assessment requirements whereas for medical students it is the interactive aspect of a system that enables them to obtain feedback on their performance in a test. For work-based learners, attitudes can be influenced by a supportive learning environment which increases motivation and decreases frustration.

## *7.3 The quality of e-Learning in higher education, medical education and work-based learning*

There were more differences than similarities in the factors that influenced the quality of technology enhanced learning in the three sectors. Unsurprisingly, there was far more emphasis on the quality of learning in the higher education studies. In medical education there were many studies that compared performance in different types of environments but, as has been found in previous reviews, there was no consensus on whether different types of online learning, blended learning, or traditional classroom learning were more effective. The quality of learning in the workplace was influenced by flexibility in terms of where and when the learning took place. Some e-Learning environments can have a beneficial effect on the quality of the learning. The literacy level of the learner had an influence on the quality of work-based e-Learning but was not mentioned (perhaps understandably) in either higher or medical education. In higher education the quality of the learning was influenced by the student's understanding of the tools and materials available, their level of computer expertise, their understanding of the assessment requirements and the presence (either virtual or physical) of a tutor. The type of task had an influence on the quality of learning for higher education and medical students but was rarely mentioned in work-based learning. Voluntary engagement in e-Learning had an influence on the quality of the learning for undergraduates and the personal involvement and enthusiasm of the tutor had a beneficial effect on the quality of the e-Learning experience for medical students. Motivation to learn was a factor that influenced the quality of e-Learning for

undergraduates and learners in the workplace but was rarely mentioned in the medical education literature.

## *7.4 Changes in behaviour due to e-Learning in higher education, medical education and work-based learning*

Studies of changes in behaviour as a consequence of e-Learning inevitably focused on the social aspect of learning. Collaboration, creating a social environment and becoming part of a learning community were facilitated as a result of interacting in an e-Learning environment for both undergraduates and learners in the workplace. Some uncertainty while working in higher education e-Learning environments facilitated learning as asking more questions led to improved learning outcomes. New technologies (e.g. PDAs) changed the way that medical students and practitioners accessed information and the acceptance of new technologies was influenced by the tutors' success in using the technologies. This has echoes in the higher education literature where faculty usage of new technologies had an influence on undergraduates' attitudes to the technologies and probably the students' future use of new technologies in learning. An interesting change in behaviour in workplace communication (and possibly learning) was in the use of technologies in order to have multiple conversations. This use of number of different media facilitated communication and collaboration.

## *7.5 The organisational impact of e-Learning in higher education, medical education and work-based learning*

The development of an e-Learning strategy in an organisation is a point where organisational factors have an impact on how well e-Learning works. The acceptance of change by those within an organisation is a key factor that has been identified in all three sectors. An understanding of how e-Learning is adopted in organisations is important and can be achieved through the evaluation of e-Learning strategies. However evaluation studies of the implementation of e-Learning strategies are not reported extensively in the three sectors. In medical education, where e-Learning is well established, the barriers are the under-utilisation of e-Learning resources and the over-reliance on technologies. For all three sectors a measure of the effectiveness of e-Learning is cost savings. Cost, however, is not mentioned extensively in the literature although a USA project looking at undergraduate e-Learning showed that changes in the organisational structure of some learning where online learning increased and faculty time decreased can lead to cost savings. Lack of time to engage in e-Learning was a factor mentioned in the medical education literature. These findings need to be tempered by findings (from the other levels of evaluation) that blended learning is preferred and that the presence of a tutor is important. A measure of e-Learning in higher education is whether the students stay on the course i.e. the issues of retention, completion, and progression to other courses. There is very little evidence for these measures. In the work-based e-Learning literature it was found that flexibility, in terms of how the technology is introduced and the expectations of the employers and employees can have an impact on the adoption of e-Learning.

# 8. Recommendations for future research and evaluations of e-Learning in the post-16 sector

## *8.1 Recommendations for reviews*

Our review of the evidence for the effectiveness of e-Learning focused on particular parts of the post-16 sector (undergraduates in higher education, medical education, and work-based e-Learning). These parts of the post-16 sector are inevitably intertwined and we have demonstrated that there are similarities between them in terms of the factors that influence what works in e-Learning. But it is the contextual nature of e-Learning in the different parts of the sector and the inherent differences in factors that influence the success of e-Learning, that are of interest. As we move towards more 'joining up' of the sectors e.g. with the DfES asking how education can best meet the workforce skills needs of employers, an understanding of what unifying factors influence how e-Learning works across the sectors is important.

## *8.2 Recommendations for what should be included in any evaluation of e-Learning*

In many of the papers that we reviewed, the learning theory that guided the planning of an intervention and its implementation was not made explicit. In this review we have produced an overview of theories that inform research on e-Learning. We do not claim that they are exhaustive but they are a starting point in a process where we need to become more explicit about how we think that students, trainees and practitioners learn.

## *8.3 Recommendations for evaluation and methodology in e-Learning*

Evidence about how well e-Learning is performing was found in a whole host of different journals, websites, conference papers and presentations emanating from a wide range of disciplines. The review of evidence for the effectiveness of e-Learning spanned a large number of disciplines within higher education e.g. cognitive science, computer science, management studies, and psychology. In medical education the review covered the learning of both students and medical practitioners and in work-based learning it was the experience and learning of the employer, the employee and the organisation itself that was of interest. Bearing in mind this diversity we outlined some of the underlying theories and approaches to e-Learning that guided and supported both the practice and the evaluations.

At the end of this review, in addition to specific recommendations about studies that should be undertaken, we believe that there is a need for an open discussion of the types of research methods used in the field of e-Learning. To a certain extent this discussion has already been opened up by Coffield et al. (2004) in their review of learning styles (see also chapters 2 and 4 in this review). The diversity of approaches to the collection of evidence for the effectiveness of e-Learning is considerable and needs to be brought together in book that is focused on research methods in e-Learning. This book would be both an interdisciplinary and 'inter-sector' textbook. This seems like a simple solution but could alleviate the problems inherent in a field

where we are trying to compare studies and interventions, which at first sight seem comparable e.g. two studies of students' attitudes to blended learning. In the field of e-Learning where there are as many attitudinal scales as there are students' attitudes, comparison is not always easy. There can be no comparative measure of students'/learners' attitudes until we know that we are using the same scale. In addition, a large number of studies use 'partial scales'. That is, attitudinal scales that have used a small number of items from a larger scale.

Rather than exclude studies on the basis of quality we have included studies where the research questions and methodology were interesting and the findings were of potential relevance to the review question. For future research in e-Learning there needs to be more coherence in how the questions in studies are asked (hypotheses are developed) and about the tools that are used to answer these questions. This is one of our strong recommendations stemming from this review of the evidence for the effectiveness of e-Learning. Scales used to measure, for example attitudes or learning styles, need to be standardised across the e-Learning field. This would help when trying to compare studies where outcome measures (e.g. learning gains) and attitudes were used. More studies need to use more than one type of research method e.g. combining observational method with a self report/questionnaire design. It is not sufficient to present the learners' attitudes assessed through a short questionnaire containing few items. The validity of these questionnaires is doubtful and therefore the validity of the studies is also a problem. Without other measures including; interview data, focus group studies, observational studies, to reinforce the findings of the surveys we cannot be sure that we are really looking at evidence.

However some of the studies that have used 'incomplete' research tools do have value. Using a thorough systematic review methodology some of these types of studies would have been excluded on the basis of quality. This is partly why there has been a movement away from the systematic review, where the inclusion criteria mean that many studies that could suggest new questions and new avenues of research are excluded. Examples of studies from our review and suggestions from previous reviews that open up new ways of looking at e-Learning include:

- A study in the work-based e-Learning review that looked at people's behaviour when using an automated banking system. This, of course, does not tell us about deep learning but it did give insight into potential variables involved in e-Learning e.g. age and gender.
- Suggestions that observation of students accessing remote learning facilities is needed
- Involvement of tutors in both face to face and virtual interactions between students. This can be beneficial or detrimental to learning depending on the type of involvement and at what level.
- Interactions using different technologies. The use of instant messaging in conjunction with other technologies was an example of behavioural change in an organisation. Again, it possibly does not tell us about deep learning but it does give us an insight into types of collaboration and cooperation facilitated by technology.

Finally, a fifth level of evaluation, the societal implications of e-Learning has only been touched on in this review. This is because there is very little evidence (see further discussion in next section). Our focus was on higher education, medical education and work-based e-Learning where the social implications were less relevant than if we had included, for example, a review of informal learning. In terms of methodology, the diffusion of innovation literature that divides the intervention into the type of attributes of an innovation (e-Learning) would be useful in developing research methods both at the organisational and the societal level. For instance, is e-Learning better than what was available before? Is it compatible with what is already happening? Can we see that it is better? Can we make it easy to use so adoption is not a problem?

## *8.4 Specific recommendations for future research*

In each section of the review chapters we made recommendations for future research. We summarise them here. In higher education we should look at

- Students' attitudes to different methods of assessment when using e-Learning
- The effect of faculty use of technology on the attitudes and behaviour of students (role modelling)
- The impact of the integration of learning activities with assessment in a networked learning environment
- When collaboration works and when it breaks down
- The impact of e-Learning strategies on the higher education institution

In medical education we should look at

- The experience of the off-campus or long distance learner
- The contextual nature of learning by including more than one level of evaluation of e-Learning e.g. gauging the reactions of the learners (self report) and also observing the behaviour
- Student, practitioner and faculty use of handheld devices in more depth
- The pattern of adoption of e-learning in the organisation through longitudinal studies

In work-based e-Learning we should look at

- The trainee's experience of e-learning in more depth
- Computer anxiety as this has been identified as a major barrier
- The interaction between literacy levels and success with e-Learning
- The use of different levels of flexibility of a system. For example the opportunity to ask questions or go beyond what is expected can influence employees
- Changes in the way that communication takes place as a result of new technologies

## 9. References


Allen, M., Mabry, E., Mattrey, M., Bourhuis, J., Titsworth, S. & Burrell, N. (2004) Evaluating the effectiveness of distance learning: A comparison using meta-analysis Journal of Communication Vol 54 no 3 p 402 –420

Aly, M., Elen, J. & Willems, G. (2005) Learner-control vs. program-control instructional multimedia: a comparison of two interactions when teaching principles of orthodontic appliances. European journal of dental education 9(4) p 157-63

Anderson, J. R. (1993) Problem Solving and Learning. American Psychologist, 48, p 35 - 44

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs, NJ: Prentice Hall.

Bangert, D., Doktor, R. & Johnson, E. (2002) Preparing healthcare professionals for telemedicine: results from educational needs research. Interactive learning environments Vol 10, No. 3 p 199 - 215

Bata-Jones, B. & Avery, M. D. (2004) Teaching pharmacology to graduate nursing students: evaluation and comparison of Web-based and face-to-face methods. The Journal of nursing education 43(4) p 185-9

Bergin, R. A. & Fors, U. G. H. (2003) Interactive simulated patient – an advanced tool for student-activated learning in medicine and healthcare Computers and Education 40 p 361 – 376

Bergin, R., Parvati, D., Youngblood, P., Ayers, M. K., Hindbeck, H., Boberg, J., Leonard, E. E., Stringer, J. R., Bolander, K., Courteille, O., Thalme, A. & Fors, U. G. (2003) Interactive simulated patient: Experiences with collaborative e-learning in medicine Journal of Educational Computing Research Vol. 29 (3) p 387 – 400

Birchall, D., & Woolfall, D. (2003). Corporate e-Learning: Delivering business benefits. Grist. London

Boivie, I., Aborg, C., Persson, J. & Lofberg, M. (2003) Why usability gets lost or usability in in-house software development Interacting with Computers Vol. 15 p 623 - 639

Boyle, M. A. & Crosby, R. (1997) Academic programme evaluation: lessons from business and industry. Journal of industrial teacher education 34, 3 p 81 – 85

Braak, J. P. (2004) Domains and determinants of university students' self-perceived computer competence Computers & Education Vol. 43 (4) p 299 – 312

Bradley, P., Oterholt, C., Herrin, J., Nordheim, L. & Bjørndal, A. (2005) Comparison of directed and self-directed learning in evidence-based medicine: a randomised controlled trial Medical education 39(10): 1027-35

Becta (2004) Research into the use of ICT and e-Learning for work-based learning in the skills sector: Literature review

Bromme, R. & Stahl, E. (2005) Is hypertext a book or a space? The impact of different introductory metaphors on a hypertext construction Computers & Education Vol. 44 p 115 – 133

Burgess, J. R. D. & Russell, J. E. A. (2003) The effectiveness of distance learning initiatives in organizations Journal of vocational behaviour Vol 63 p 289 – 303

Byrnes, J. P. (2001) Cognitive Development and Learning in Instructional Contexts USA Allyn and Bacon

Calcaterra, A., Alessandro, A. & Underwood, J. (2005) Cognitive style, hypermedia navigation and learning Computers & Education Vol. 44 p 441 - 457

Calisir, F. & Calisir, F. (2004) The relation of interface usability characteristics, perceived usefulness, and perceived ease of use to end-user satisfaction with enterprise resource planning (ERP) systems Computers in Human Behavior Vol. 20 (4) p 505 - 515

Cameron, A. F. & Webster, J. (2005) Unintended consequences of emerging communication technologies: Instant messaging in the workplace Computers in Human Behavior Vol. 21 p 85 - 103

Childs, S., Blenkinsopp, E., Hall, A. & Walton, G. (2005) Effective e-learning for health professionals and students—barriers and their solutions. A systematic review of the literature—findings from the HeXL project. Health Information & Libraries Journal 22, 2, p 20-32

Clarke, A., Lewis, D. & Cole, I. (2005) A strategic approach to developing e-learning capability for healthcare. Health information and libraries journal.) 2005 Dec; 22 Suppl 2: 33-41

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Learning styles and pedagogy in post-16 learning? Learning and Skills Research Centre LSDA

Coleman, G., Rea, T., Hall, M., Sawyer, A. & Hemsworth, P. H. (2001) Multimedia training in the pig industry. Computers & Education Vol. 37 (3-4) p 257 - 271

Collins, C., Buhalis, D. & Peters, M. (2003) Enhancing SMTEs' business through the internet and e-learning platforms. Education and Training Vol 45, Iss 8/9 p 483 – 495

Collonia-Willner, R. (2004) Self-service systems: new methodology reveals customer real-time actions during merger Computers in Human Behavior Vol. 20 (2) p 243 - 267

Curran, V., Kirby, F., Allen, . & Sargeant, J. (2003) A mixed learning technology approach to continuing medical education. Medical education online 8, 5 p 1 – 11

Demb, A., Erickson, D. & Hawkins-Wilding, S. (2004) The laptop alternative: Student reactions and strategic implications Computers & Education Vol. 42 (3) p 383 - 401

Department for Education and Skills (2003) Towards a unified e-learning strategy Available at http://www.dfes.gov.uk/consultations

Department for Education and Skills (2005) The e-Strategy - Harnessing Technology: Transforming learning and children's services http://www.dfes.gov.uk/publications/e-strategy/

Department of Health (2005) Introducing the NHS Institute for Innovation and Improvement
http://www.dh.gov.uk/NewsHome/NewsArticle/fs/en?CONTENT_ID =4114843&chk=m51qEV

Department of Health (2003) Building E-Learning Capacity for the Social work Degree A Scoping Study for the Department of Health E-Learning Steering Group Available at http://www.doh.gov.uk/swqualification

Dillich, S. (2000) Corporate universities: More companies are creating their own corporate universities in order to train employees. Computing Canada. p25.

Dobson, M. W., Pengelly, M., Sime, J. A., Albaladejo, S. A., Garcia, E. V., Gonzales, F. & Maseda, J. M. (2001) Situated learning with co-operative simulations in team training Computers in Human Behavior 17 p 547 – 573

Doyle, D. J. (2002) Simulation in medical education: Focus on anesthesiology, Medical Education online 7:16 p 1 – 7

Dørup, J. (2004) Experience and attitudes to information technology among first-year medical students in Denmark: Longitudinal questionnaire survey. Journal of medical internet research Vol 6, 1 (Jan – March 2004) p 1 -6

Du Boulay, B. (2000) Can we learn from ITSs? In Gilles Gauthier, Claude Frasson, and Kurt VanLehn, editors, Intelligent Tutoring Systems: Proceedings of 5th International
Conference, ITS 2000, Montreal, number 1839 in Lectures Notes in Computer

Science, pages 9-17. Springer-Verlag
http://www.cogs.susx.ac.uk/users/bend/papers/its2000.pdf

Dunser, A. & Jirasko, M. (2005) Interaction of hypertext forms and global versus sequential learning styles Journal of educational computing research
Vol. 32 (1) p 79 – 91

Dweck, C. S. (1999) Self Theories: Their Role in Motivation, Personality, and Development USA Taylor Francis

Eraut M, Alderton J, Cole G, Senker P (2000) Development of knowledge and skills at work, in F, Coffield (ed) Differing visions of a learning society (Bristol: Polity Press)

Erlich, Z., Erlich-Philip, I. & Gal-Ezer, J. (2005) Skills required for participating in CMC courses: An empirical study Computers & Education Vol. 44 (3) p 477 – 487

ESRC Info Centre 'Technology enhanced learning' (2006)
http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Images/forthcoming_tel_call_tcm6-14127.pdf

Euliano, T. Y., Lee, A. I., Melker, J., Ilona, M. & Schmalfuss, M. (2003) Development and evaluation of an internet-based airway evaluation tutorial. Medical education online 8, 18 p 1 -5

Evans, C., Gibbons, N. J., Shah, K. & Griffin, D. K. (2004) Virtual learning in the biological sciences: pitfalls of simply "putting notes on the web" Computers & Education Vol. 43 p 49 – 61

Eynon, R. (2004) Systematic Review On Web Based Education
Centre for Research in Medical and Dental Education
http://www.education.bham.ac.uk/research/crmde/research/past/best_ev.htm

Finley, J. P., Sharratt, G. P., Nanton, M. A. Chen, R. P., Roy, D. L & Paterson, G. (1998) Auscultation of the heart: a trial of classroom teaching versus computer-based independent learning. Medical Education 32 p 357 – 361

Fletcher, J. D. & Johnston, R. (20002) Effectiveness and cost benefits of computer-based decision aids for equipment maintenance 18 p 717 – 728

Ford, N. & Murpy, G. (2002) The development and piloting of a training web site for health and safety enforcement officers British Journal of Educational technology Vol. 33 (1) p 65 – 76

Gagne, R. M. (1962). Military training and principles of learning. American Psychologist, 17, p 263 - 276.

Gagné, R. M. (1985) The conditions of learning and theory of instruction. 4th edition. New York: Holt, Rinehart, and Winston.

Ganger, A. C. & Jackson, M. (2003) Wireless handheld computers in the preclinical undergraduate curriculum. Medical Education Online 8:3 p 1 – 7

Garland, K. & Noyes, J. (2004) Changes in learning expectations and confidence toward computers: a study of five successive years of undergraduates Journal of educational computing research Vol. 31 (3) p 273 – 279

Gould, D. J. (2001) The Brachial Plexus: Development and assessment of a computer based learning tool. Medical Education Online 6, 9 p 1 -7

Grabe, M. (2005) Voluntary use of online lecture notes: correlates of note use and note use as an alternative to class attendance Computers & Education Vol. 44 p 409 - 421

Greenhalgh, P. (2001) Computer assisted learning in undergraduate education. British Medical Journal 322, p 40 -44

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., Kyriakidou, O. & Peacock, R. (2005) Storylines of research: a meta-narrative perspective on systematic review. Social Science and Medicine; 61: p 417-430

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. & Kyriakidou, O. (2004) Diffusion of innovations in service organisations: systematic literature review and recommendations for future research. Milbank Quarterly, 82, p 581-629

Guerandel, A., Fell, P. & Malone, K. (2003) Computer assisted learning in undergraduate psychiatry (CAL-PSYCH): evaluation of a pilot programme. Irish Journal of Psychological Medicine 20 (3) p 84 - 87

Gulikers, J. T. M., Bastiaens, T. J. & Martens, R. L. (2005) The surplus value of an authentic learning environment Computers in human behavior Vol. 21 p 509 – 521

Gupta, B., White, D. A. & Walmsley, A. D. (2004) The attitudes of undergraduate students and staff to the use of electronic learning. British Dental Journal 196, 8 p 487 - 492

Hahne, A. K., Benndorf, R., Frey, P. & Herzig, S. (2005) Attitude towards computer-based learning: determinants as revealed by a controlled interventional study. Medical Education 39(9): 935-43

Harden, R. M. (2005) A new vision for distance learning and continuing medical education. The Journal of continuing education in the health professions 25, 1 p 43 - 51

Harrington, S. S. & Walker, B. L. (2004) The effects of computer-based training on immediate and residual learning of nursing facility staff. Journal of continuing education in nursing. 35(4) p 154-63

Hassan, X., Hauger, D., Nye, G. & Smith, P. (2005) The use and effectiveness of synchronous audiographic conferencing in modern language teaching and learning (online language tuition): a systematic review of available research http://eppi.ioe.ac.uk/EPPIWeb/home.aspx?page=/reel/review_groups/MFL/review_three_abstract.htm

HE Academy (2005) The Higher Education Academy http://www.heacademy.ac.uk/e-learning.htm

Hearn, D. R. (2001) Education in the Workplace: An Examination of Corporate University Models http://www.newfoundations.com/OrgTheory/Hearn721.html

Heckman, R. & Annabi, H. (2005) A content analysis comparison of learning processes in online and face-to-face case study discussion Journal of Computer-Mediated Communication & Education Vol. 42 (3) p 87 - 107

Hennessey, T. & Sawchuk, P. H. (2003) Worker responses to technological change in the Canadian public sector: issues of learning and labour process Journal of workplace learning Vol. 15 (7/8) p 317 - 332

Higher Education Funding Council for England (2005) HEFCE Strategy for e-Learning http://www.hefce.ac.uk/pubs/hefce/2005/05_12/05_12.pdf

Hills, H. & Kappler, S. (2004) Embedding e-learning in large organisations. A report commissioned by learndirect and undertaken by HI Europe

Hilton, S. R. & Slotnick, H. B. (2005) Proto-professionalism: how professionalisation occurs across the continuum of medical education. Medical Education 39 p 58 - 65

Huang, H. M. & Liaw, S. S. (2005) Exploring users' attitudes and intentions toward the web as a survey tool Computers in human behavior Vol. 21 p 729 – 743

Jackson, M., Ganger, A. C., Bridge, P. D. & Ginsberg, K. (2005) Wireless handheld computers in the undergraduate medical curriculum. Medical Education Online 10:5 p 1 – 11

Jaffe, J. M. (1997) Media interactivity and self-efficacy: an examination of hypermedia first aid instruction. Journal of Heath Communication Vol 2 p 235 – 251

JISC (2005) JISC welcomes the new DfES e-Learning strategy
http://www.jisc.ac.uk/index.cfm?name=news_estrategy

Karnath, B. M., Das Carlo, M. & Holden, M. D. (2004) A comparison of faculty-led small group learning in combination with computer-based instruction versus computer-based instruction alone on identifying simulated pulmonary sounds. Teaching and learning in medicine. 16(1) p 23-7

Kaufman, R. & Keller, J. M. (1994) Levels of evaluation: Beyond Kirkpatrick Human Resource Development Quarterly. Vol.5, Iss. 4; p 371 - 381

Kaufman, R., Keller, J., & Watkins, R. (1995). What works and what doesn't: Evaluation beyond Kirkpatrick. Performance & Instruction, 35, (2). 205-209.

Kekeale, T., Pirolt, K. & Falter, C. (2002) IT tools in personnel training in small enterprises: results of Project "Apply" Journal of workplace learning Vol. 14 (7/8) p 269 - 277

Khalid, H., Swift, H. & Cullingford, C. (2002) The new office technology and its effect on secretaries and managers Education and Information Technologies Vol. 7 (3) p 257 - 274

Kirkpatrick's training evaluation model
http://www.businessballs.com/kirkpatricklearningevaluationmodel.htm

Kirkpatrick, D. L. (1998). Evaluating Training Programs: The Four Levels, 2nd ed. San Francisco: Berrett-Koehler.

Kumta, S. M., Tsang, P. L., Hung, L. K. & Cheng, J. C. Y. (2003) Fostering critical thinking skills through a web-based tutorial programme for final year medical students – a randomized controlled study Journal of educational multimedia and hypermedia 12 (3) p 267 – 273

Lahn, L. C. (2004) Dilemmas in the development of e-Learning at work Journal of workplace learning Vol. 6 (7/8) p 466 - 478

Lain, D. & Aston, J. (2004) Literature review of evidence on e-Learning in the workplace Institute for Employment Studies

Lapinsky, S. E., Wax, R., Showalter, R., Carlos Martinez-Motta, J., Hallett, D., Mehta, S., Burry, L. & and Stewart, T. E. (2004) Prospective evaluation of an internet-linked handheld computer critical care knowledge access system. Critical Care 8 p 414 – 421
http://ccforum.com/content/pdf/cc2967.pdf (accessed 14/11/05)

Lau, F. & Bates, J. (2004) A review of e-learning practices for undergraduate medical education. Journal of medical systems 28 1 p 71 - 87

Laurillard, D. (2002) Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies. London Routledge Falmer

Learningcircuits (2005) http://www.learningcircuits.org/glossary.html accessed 29th August 2005

Learning and Skills Council (2005) Agenda for change http://www.lsc.gov.uk/National/Partners/PolicyandDevelopment/lsc_agenda_for_change.htm

Lechner, S. K., Kandlbinder, P., Gonsalkorale, S., Bradshaw, M., Harris, K. M. & Winning, T. (2001) Negotiating the maze: Case based, collaborative distance learning in dentistry. Medical education online 6:3 p 1 – 6

Lee, C. H. M., Cheng, Y. W., Rai, S. & Depickere (2005) What affect student cognitive style in the development of hypermedia system? Computers & Education Vol. 45 p 1 – 19

Lei, L. W., Winn, W., Scott, C. & Farr, A. (2005) Evaluation of computer-assisted instruction in histology: effect of interaction on learning outcome. Anatomical record. Part B, New anatomist 284(1) p 28-34

Levine, A. E. (2002) Evaluation of world wide web-based lessons for a first year dental biochemistry course medical education online 7:3 p 1 – 9

Luarn, P. & Lin, H. (2005) Toward an understanding of the behavioral intention to use the mobile banking Computers in Human Behavior Vol. 21 (6) p 873 – 891

Maag, M. (2004) The effectiveness of an interactive multimedia learning tool on nursing students' math knowledge and self-efficacy. Computers, informatics, nursing : CIN 22(1) p 26-33

Macdonald, J. & Twining, P. (2002) Assessing activity-based learning for a networked course British Journal of Educational Technology Vol 33 (5) p 603 – 618

Macpherson, A., Homan, G. & Wilkinson, K. (2005) The implementation and use of e-learning in the corporate university Journal of workplace learning Vol. 17 (1/2) p 33 - 48

Makitalo, K., Weinberger, A., Paivi, H., Jarvela, S. & Fischer, F. (2005) Epistemic cooperation scripts in online learning environments: fostering learning by reducing uncertainty Computers in Human Behavior Vol. 21 p 603 – 622

Malloy, M. H. (2002) Enhanced web-based otitis study case vs simple paper-case: Impact on medical student objective structured clinical exam (OSCE) performance Medical education online 7:1 p 1 – 9

Martens, R. L., Gulikers, J. & Bastiaens, T. (2004) The impact of intrinsic motivation on e-learning in authentic computer tasks Journal of computer assisted learning Vol. 20 p 368 - 376

Masino, G. & Zamarian, M. (2003) Information technology artifacts as structuring devices in organizations: design, appropriation and use of issues Interacting with Computers Vol. 15 p 693 – 707

Massielo, I., Ramberg, R. & Lonka, K. (2005) Attitudes to the application of a Web-based learning system in a microbiology course. Computers and Education 45 p 171 – 185

McAlister, S. Ravenscroft, A. & Scanlon, E. (2004) Combining interaction and context design to support collaborative argumentation using a toll for synchronous Computer Mediated Communication Vol. 20 p 194 – 204

McClennen, S., Nathanson, L. A., Safran, C. & Goldberger, A. L. (2003) ECG Wave-maven: An internet-based electrocardiography self-assessment program for students and clinicians. Medical Education Online 8:2 p 1 - 5

McDonald, D. (2001) The influence of multimedia training on users' attitudes: lessons learned Computers & Education Vol. 42 p 195 – 214

Mikkelsen, A., Øgaard, T., Lindø, P. H. & Olsen, O. E. (2002) Job characteristics and computer anxiety in the production industry Computers in Human Behavior Vol. 18 (3) p 223 - 239

Miller, J., Shaw-Kokot, J. R., Arnold, M. S., Boggin, T., Crowell, K. E., Allegri, F., Blue, J. H. & Berrier, S. B. (2005) A study of personal digital assistants to enhance undergraduate clinical nursing education. The Journal of Nursing Education 44(1) p 19-26

Mitchell, T. J., Chen, S. Y. & Macredie, R. D. (2005) Hypermedia learning and prior knowledge: domain expertise vs. system expertise Journal of computer assisted learning
Vol. 21 p 53 – 64

Mitchell, N. (2004) Where is e-learning now? The training foundation http://www.trainingfoundation.com/articles/default.asp?PageID=1681#top

Morris, E. (2001) The design and evaluation of Link: A computer-based learning system for correlation British Journal of Educational Technology Vol 32 (1) 39 – 52

Morrison, D. (2003) E-Learning Strategies: How to get implementation and delivery right first time Chichester, England John Wiley and Sons Ltd

Naidr, J. P., Adla, T. & Janda, A. (2004) Long-term retention of knowledge after a distance course in medical informatics at Charles University Prague Teaching and learning in medicine 16, 3 p 255 - 259

Newell, A. & Simon, H. (1972) Human Problem Solving Englewood Cliffs NJ: Erlbaum

Newton, D., Hase, S. & Ellis, A. (2002) Effective implementation of online learning: a case study of the Queensland mining industry Journal of workplace learning Vol. 14 (4) p 156 - 165

Nickols, F. W. (2005) Why a Stakeholder Approach to Evaluating Training Advances in Developing Human Resources. Vol.7, Iss. 1; p 121 - 135

Nicol, D. J. & MacLeod, I. A. (2005) Using shared workspace and wireless laptops to improve collaborative project learning in an engineering design class Computers & Education Vol. 44 p 477 – 487

Nowak, K. L., Watt, J. & Walther, J. B. (2005) The influence of synchrony and sensory modality on the person perception process in computer- mediated groups Journal of computer-mediated communication Vol. 10 (3) Article 3

Oliver, M. & Conole, G. (2003) Evidence-based practice and e-learning in Higher Education: can we and should we? Research Papers in Education 18(4) December 2003, pp. 385–397

Olsson, E. & Jansson, A. (2005) Participatory design with train drivers – a process analysis Interacting with Computers Vol. 17 p 147 - 166

O'Neill, K., Singh, G. & O'Donoghue, J. (2004) Implementing eLearning Programmes for Higher Education: A Review of the Literature Journal of Information Technology Education Volume 3, 2004

Osman, L. M. & Muir, A. L. (1994) Computer skills and attitudes to computer-aided learning among medical students Medical Education 28 p 381 - 385

Pawson, R., Greenhalgh, T., Harvey, G. & Walshe, K. (2004) Realist synthesis: an introduction ESRC Research Methods Programme University of Manchester RMP Methods Paper 2/2004

Pearce, J. M., Ainley, M. & Howard, S. (2005) The ebb and flow of online learning Computers in human behavior Vol. 21 p 745 - 771

Piaget, J. (1962) Plays, dreams and imitation in childhood London Routledge

Piaget, J. (1971) Structuralism London Routledge

Pittard, V. (2004) Evidence for e-learning policy. Technology, pedagogy and education Vol 13, No. 2 p 181 – 194

Potosky, D. (2002) A field study of computer efficacy beliefs as an outcome of training: the role of computer playfulness, computer knowledge, and performance during training Computers in Human Behavior Vol. 18 (3) p 241 – 25

Reisslein, J., Seeling, P. & Reisslein (2005) Integrating emerging topics through online team design in a hybrid communication networks course: Interaction patterns and impact of prior knowledge Internet and higher education Vol. 8 p 145 – 165

Rhodes, E. & Carter, R. (2003) Collaborative learning in advanced supply systems: the KLASS pilot project Vol. 15 (6) p 271 – 279

Riffel, S. & Sibley, D. (2005) Using web-based instruction to improve large undergraduate biology courses: An evaluation of a hybrid course Computers & Education
Vol. 44 (3) p 217 – 235

Rogers, E. (2003) Diffusion of innovations Fifth Edition New York Free Press

Rosenberg, H., Grad, H. A. & Matear, D. W. (2003) The effectiveness of computer-aided, self-instructional programs in dental education: a systematic review of the literature. Journal of dental education 67(5) p 524-32

Rosenberg, M. (2001) e-learning New York McGraw-Hill

Russell, D., Calvey, D. & Banks, M. (2003) Creating new learning communities: towards effective e-learning production Journal of workplace learning Vol. 36 (4) p 317 - 332

Sambrook, S. (2003) e-Learning in small organizations. Education and Training, 45 (8/9) p 506 – 516

Sandars, J. & Walsh, K. (2004) E-learning for general practitioners: lessons from the recent literature. Work Based Learning in Primary Care, Volume 2, Number 4, 2004, p 305-314 (10)

Sargeant, J., Curran, V., Jarvis-Selinger, S., Ferrier, S., Allen, M., Kirby, F. & Ho, K. (2004) Interactive on-line continuing medical education: physicians' perceptions and experiences. The Journal of continuing education in the health professions 24(4) p 227-36

Scheines, R., Leinhardt, G., Smith, J. & Cho, Kwangsu (2005) Replacing lecture with web-based course materials Journal of educational Computing research Vol. 32 (1) p 1 – 26

Schellens, T. & Valcke, M. (2005) Collaborative learning in asynchronous discussion groups: what about the impact on cognitive processing?
Computers in human behavior Vol. 21 p 957 – 975

Seagraves L, Osborne M, Neal P, Dockrell R, Hartshorn C, Boyd A (1996) Learning in smaller companies (LISC), Final Report, University of Stirling Educational Policy and Development

Sharpe, R. & Benfield, G. (2005) The student experience of e-Learning in higher education: A review of the literature. Brookes eJournal of learning and teaching Vol 1, 3 p 1 -22

Simons, H. (2003) Evidence-based practice: panacea or over promise? Research Papers in Education 18, 4 p 303 - 311

Sleight, D., Reznich, C., Yelon, S. & Williamson, J. (2003) Creating online lessons: a faculty development seminar series. Medical education online 8, 7 p 1 – 7

Smith, E. E. (1989) Concepts and Induction. In M. I. Posner (Ed.), Foundations of Cognitive Science (p 501 – 526) Cambridge, MA MIT Press

Sommerlad E (1996) Work-based learning for enterprise renewal, cited in Brennan J and Little B (1996) A review of work-based learning in higher education, London: DfEE

Summers Holtrop, J. (2001) An electronic mail list for a network of family practice residency programs: a good idea? Medical education online 6:5 p 1 - 5

Svensson, L. & Ellstrom, P. E. (2004) Integrating formal and informal learning at work Journal of workplace learning Vol. 16 (7/8) p 479 – 491

Tani Botticelli, A., Schittek Janda, M., Botticelli, D. Mattheos, N. & Attström, R. (2005) The effectiveness of video support in the teaching of manual skills related to initial periodontal therapy tested on phantoms International journal of computerized dentistry 8(2) p 117-27

Tao, Y. H., Ho, I. F. & Yeh, R. C. (2001) Building a user-based model for web executive learning systems – a study of Taiwan's medium manufacturing companies Computers & Education Vol. 36 (4) p 317 - 332

Taylor, J., Desforges, C. Goodfellow, R., Mason, R., Pegler, C. & Beetham, H. (2004) Research Priorities for E-Learning: A Consultation Introductory Document Open University, EPSRC, ESRC & e-Science dti

Taylor, J., Rico, M. & Hardy, P. (2004) e-Learning research consultation: Research priorities for e-learning. OU knowledge network http://kn.open.ac.uk/public/index.cfm?wpid=2843

Taylor, S. (2003) Corporate Universities and the Redefinition of a Medieval Brand. International Higher Education, http://www.bc.edu/bc_org/avp/soe/cihe/newsletter/News30/text002.htm

Thornton, P. & Houser, C. (2005) Using mobile phones in English education Journal of computer assisted learning Vol. 21 (3) p 217 – 228

Torre, D. M., Pfeifer, K. J., Lamb, G. C., Walters, M. P., Sebastian, J. L. & Simpson, D. E. (2004) An assessment of the impact of multimedia technology-based learning tools on the cardiac auscultation skills of the third-year medical students Medical education online 9, 22 p 1 – 8

Twigg, C. A. (2003) Improving learning and reducing costs: lessons learned from round 1 of the Pew Grant Program in Course Redesign Center for Academic Transformation Rensselaer Polytechnic Institute http://www.center.rpi.edu/PewGrant/Rd1intro.html

University for Industry http://www.ufi.com/home/default.asp accessed 29th August 2005

University of Leeds (1996) Work-based Learning Project, Final Report

Vivekananda-Schmidt, P., Lewis, M. & Hassell, A. B. (2005) Cluster randomized controlled trial of the impact of a computer-assisted learning package on the learning of musculoskeletal examination skills by undergraduate medical students Arthritis and rheumatism 53(5) p 764-71

Vygotsky, L. (1962) Thought and Language Cambridge MA MIT Press

Vygotsky, L. (1978) Mind in Society The Development of Higher Psychological Processes Cambridge MA Harvard University Press

Waller, V. & Wilson, J. (2001) BAOL 'Open Learning Today' Issue 58 http://www.british-learning.org.uk/PDF/OLT/Issue%2058/wilson.pdf

Walton, G. Childs, S. & Blenkinsopp, E. (2005) Using mobile technologies to give health students access to learning resources in the UK community setting Health information and libraries journal 22 (s2), 51-65. doi: 10.1111/ j.1470-3327.2005.00615.x

Wang, F. K. (2002) Designing a case-based e-learning system: What, how, why Journal of workplace learning Vol 14, 1/2, p 29 – 43

Wastlund, E., Reinikka, H., Norlander, T. & Archer, T. (2005) Effects of VDT and paper presentation on consumption and production of information: Psychological and physiological factors Computers in human behavior Vol. 21 p 377 – 394

Weber, B., Schneider, B., Fritze, J., Gille, B., Hornung, S., Kűhner, T. & Maurer, K. (2003) Acceptance of computerized compared to paper-and-pencil assessment in psychiatric inpatients. Computers in human behavior 19 p 81 – 93

Weiner, B. (1990) History of Motivational Research in Education Journal of Educational Psychology Vol, 82, No. 4 p 616 - 622
Welsh, E., Wanberg, C., Brown, K. & Simmering, M. (2003) E-Learning: emerging issues, empirical results and future directions. International Journal of Training and Development, 8 (4), p 245-258

Wiecha, J. W., Gramling, R. Joachim, P., Vanderschmidt, H. (2003) Collaborative e-Learning Using Streaming Video and Asynchronous Discussion Boards to Teach the Cognitive Foundation of Medical Interviewing: A Case Study Journal of Medical Internet Research 5(2):e13 http://www.jmir.org/2003/2/e13/

Wilkinson, A., Forbes, A., Bloomfield, J. Fincham Gee, C. (2004) An exploration of four web-based open and flexible learning modules in post-registration nurse education International journal of nursing studies 41(4) p 411-24

Wilson, E., V. (2004) ExamNet asynchronous learning network: augmenting face-to-face courses with student-developed exam questions. Computers & Education Vol. 42 (3) p 87 - 107

Winnips, K. & Collis, B. (2004) Learning productivity: a case analysis of the 'e-BOSNO' course for manager teams British Journal of Educational Technology Vol. 35 (4) p 443 – 460

Workman, M. (2005) Expert decision support system use, disuse, and misuse: a study using the theory of planned behavior Computers in Human Behavior Vol. 21 (2) p 211 - 231

Zhang, Y. (2005) Age, gender and internet attitudes among employees in the business world Computers in Human Behavior Vol. 21 (1) p 1 - 10

# Appendices

## *Appendix 1 . Definitions of e-Learning*

**1. Education**

The Department for Education and Skills consultation document 'Towards a Unified e-learning Strategy' presents us with a broad definition

If someone is learning in a way that uses information and communications technologies (ICTs), they are using e-learning (DfES, 2003)

Brunel University (2004) equates an e-learning strategy with web-enhanced learning.

Bristol University (2003) defines e-learning as

The use of electronic technology and media to deliver, support and enhance teaching, learning and assessment. It includes elements of communication within and between communities of learners and teachers, as well as provision of online content, which may be locally generated or developed elsewhere (draft e-learning strategy)

**2. Learning and Skills Sector**

The term Information Learning Technology (ILT) is used, particularly in Further Education, to refer to the use of computer and communications technologies for learning and the management of learning (LSDA, 2003). The Learning and Skills Council (LSC) and the Learning and Skills Development Agency (LSDA) acknowledge that the term e-learning could be used in its place. They use a definition of e-learning which states that e-learning is a

> Term covering a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio and videotape, satellite broadcast, interactive TV, CD-ROM, and more.

LSDA (2003) also define e-learning as

> The use of electronic technology to deliver, support and enhance teaching and learning

The LSC use a DfES definition of e-learning

> E-learning is defined as learning with the aid of information and communications technology tools. These may include the Internet, intranets, computer-based technology, or interactive television. They may also include the use of e-technology to support traditional methods of learning, for example using electronic whiteboards or video conferencing.

**3. Health Sector**

The Department for Health (2003) cites Rosenburg's (2001) definition

> e-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance

and point out that e-learning incorporates (1) formal knowledge and learning

resources (2) learning networks (3) contact, administration and assessment (4) information management skills.

**4. Commercial/Training Sector**

The Training Foundation's definition of e-learning is

> A learning environment supported by continuous and collaborative processes focused on increasing individual and organisational performance.

The definition of e-learning in a review by the Knowledge and Learning Systems Group in 2000 focusing on training is as follows

> e-learning is the acquisition and use of knowledge distributed and facilitated by electronic means.

'Open Learning Today' (2001) includes a definition of e-learning by Waller and Wilson

> e-learning is the effective learning process created by combining digitally delivered content with (learning) support and services.

The Australian National Training Authority (ANTA) proposes that

> e-learning is a broader concept [than online learning], encompassing a wide set of applications and processes which use all available electronic media to deliver vocational education and training more flexibly…the general intent to support a broad range of electronic media (internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV and CD-ROM) to make vocational learning more flexible for clients.

There is also a discussion of the difference between 'delivery' and 'learning'. It is suggested that the shift in the usage of these terms reflects the movement from the instrumentalist approach to the constructivist approach. They also suggest a continuum where online learning is a subset of e-learning and e-learning is a subset of flexible learning. They suggest that online and e-learning are about specific technologies whereas flexible learning is a philosophy and approach within which the use of technology is one component.

**5. Across sectors/funding bodies**

A joint SFEFC/SHEFE e-learning group final report (2003) found the following definition helpful (but in need of 'unpacking')

> Networked access to digital learning materials and communication systems to deliver and support learning.

One of the conclusions reached in this report was that 'e-learning is fundamentally about learning and not about technology. Strategic development of e-learning should be based on the needs and demands of learners.'

**6. Is it important to have a definition?**

A USA university (Plymouth State) defines e-learning as

Refers to any type of learning that uses electronic media. It means many different things to people but is a popular media buzz word and should be avoided.

## *Appendix 2. List of search terms produced at the start of our review*

| **SEARCH TERMS** | | |
|---|---|---|
| ***e-Learning*** | ***Impact*** | ***Sector/Types of Programme*** |
| Elearning | Effectiveness | Higher Education |
| e-Learning | Effect | Undergraduate |
| Computers | Affect | Postgraduate |
| Computer applications | Power | Training |
| Computer games | Weight | Further Education |
| Computer software | Warrant | Adult |
| Computer-Mediated-Communication (CMC) | Merit | Adult learning |
| Computer-Supported-Collaborative- Learning (CSCL) | Value | Adults |
| | Advantage | Adults Learning |
| Computer Aided Learning (CAL) | Worth | Vocational Education |
| Computer Assisted Instruction (CAI) | Importance | Vocational Training |
| Computer Assisted Learning (CAL) | Significance | Modern Apprenticeship |
| Computer Assisted Language Learning (CALL) | Force | Informal Learning |
| Computer Based Learning (CBL) | Cost | A level |
| Intelligent Tutoring System (ITS) | | GNVQ |
| Computer Based Instruction | | NVQ |
| Computer Based Tutor | | Access Courses |
| Computer based training | | OCN |
| Electronic communication | | Post 16 |
| Information systems | | 16-19 |
| Information-Communications-Technology (ICT) | | Community |
| Information and Learning Technology (ILT) | | University |
| Integrated Learning Systems (ILS) | | |
| Internet | | |
| Learning Management Systems | | |
| Managed Learning Environments (MLE) | | |
| Multi-media | | |
| Networked learning | | |
| Online learning | | |
| t-learning | | |
| Word-processing | | |
| Virtual Learning Environments (VLE) | | |

Key words for the review question 'How compelling is the evidence for the effectiveness of e-Learning in the post-16 sector?'

## *Appendix 3 . List of databases and journals used in the search*

Databases included; ERIC, BEI, PSYCINFO, MEDLINE, ABI

Academic Medicine
ALT J
Artificial Intelligence in Medicine
British Journal of Educational Technology
British Journal of Medical Practice
British Medical Journal
Computers and Education
Computers in Human Behavior
Education and Information Technologies
Educational Psychology Review
Interacting with Computers
Interactive Learning Environments
Journal of Computer Assisted Learning
Journal of Computer Mediated Communication
Journal of Educational Computing Research
Journal of Education Policy
Journal of Workplace Learning
Learning and Instruction
Medical Education
Medical Education Online
Postgraduate Medical Journal
Teaching and Learning in Medicine
Technology in Society

## *Appendix 4. Acronyms*

**BECTA** British Educational Communications and Technology Agency
**DfES** Department for Education and Skills
**DOH** Department of Health
**DTI** Department for Trade and Industry
**HEA** Higher Education Academy
**HE** Higher Education
**HEFCE** Higher Education Funding Council for England
**JISC** Joint Information Systems Committee
**LSC** Learning and Skills Council
**LSDA** Learning and Skills Development Agency
**QAA** Quality Assurance Agency (for higher education)
**Ufi** University for Industry
**WBL** Work-based learning

## *Appendix 5. Measures of effectiveness*

**Table A5.1 Measures of effectiveness of e-Learning based on evidence collated and 2nd Expert Seminar feedback**

| Process/outcome measures of effectiveness of e-Learning (with definitions) | |
|---|---|
| **Process** | **Outcomes** |
| **Interactivity** – linked to communication and collaboration. The use of tools to aid and facilitate interaction with the learning object and with others. | **Activities** – achieved more effectively in e-Learning environment than in non-e-Learning environment. |
| **Collaboration** – Learning through the sharing and exchanging of information (knowledge) among a peer group. Increasing learning capacity. The mediation of collaborative learning through computers. | **Collaboration** – Learning through the sharing and exchanging of information (knowledge) among a peer group. Increasing learning capacity. The mediation of collaborative learning through computers. |
| **Engagement** – The process through which the learner becomes attentive, curious, and willing participant. This also has relevance to the notion of flow (the feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment). For instance, a degree of engagement could be measured by the willingness to work with the system beyond the designated time. | **Costs** – (1) Keeping student enrollments the same while reducing instructional resources.<br>(2) Reducing course expenditure by decreasing the number of repetitions.<br>(3) Reducing faculty time and transferring some tasks to technology assisted activities |
| **Motivation** – used here to describe the initiation, direction, intensity, and persistence of someone's behaviour in relation to learning. Intrinsic and extrinsic motivation also need to be taken into account. | **Learning gains** – attainment and achievement.<br>**Learning outcomes –** measurement of student learning – the ability to produce evidence of progress. This is linked to e-portfolios and further education as well.<br>**Pass rate** – linked to quality enhancement - when more students pass at a higher level |
| **Student/learner experience** – How do students behave during their learning experience?<br>How are students changed by their learning experience? | **Learning skills** – e.g the ability to use metacognitive strategies in order to become successful learners |
| **Flexibility** – the extent to which e-Learning allows people to learn at their own pace and in their own time. | **Retention** – This term refers to retention, withdrawal and failure in both higher and further education. Of course, it could also refer to retention on an informal course. A related term would be |

| | |
|---|---|
| | 'drop out' |
| **Social relationships** - feeling of connection. | **Employability** – e-Learning experience leads to greater value in job market. |
| **Metacognition -** this includes the acquiring of metacognitive knowledge and metacognitive experiences or regulation. This aids the development of a deeper understanding of one's own learning. | **Attitudes** – to material or to learning in general |
| | **Recruitment** – linked to attitudes to the internet. The relationship of recruitment of undergraduates through the internet and post-entry attitudes. It is seen as a formal approach to information gathering – not learning. |
| | **Quality improvement** – (1) e-Learning makes it easier for students to learn (2) students learn more as a result of e-Learning. |

**Table A5.2 Factors that contribute to the effectiveness of e-Learning based on evidence collated and 2nd Expert Seminar feedback**

| Process and outcome factors that contribute to the effectiveness of e-Learning |
|---|
| **Physical Accessibility** – Can the person get to a computer?<br>**Social Accessibility** – Even if there is a computer available does the person feel comfortable and have the training to use it?<br>**Accessibility linked to HCI design issues** - when the person has a computer, is willing to use it, but the software is not suitable for the purpose. |
| **Assessment** – (1) The extent to which assessment supports student learning and participation (2) The factors influencing the effective design of assessment for activity-based learning in networked environments |
| **Social presence** – linked to communication<br>(1) The ability to define social relationships with reference to the environmental context, divorced from pre-existing relationships<br>(2) The social presence of a virtual tutor mediated by verbal written information, by written information and various personal<br>views, by written and spoken information, by text, by views and spoken language<br>(3) The sense of being together created by the use of telecommunications systems<br>(4) The disappearance of the computer interface in an interaction |
| **Personalisation** – The tailoring of the learning facilities to meet individual needs and current activity. Linked to e-portfolios. |
| **Willingness to engage with e-Learning** – rather than being forced to use it e.g. a teacher taking time and trouble to reflect on their practice rather than bending to external pressure |