Factors Determining the Overall Effectiveness of e-Learning Systems used in Higher Education

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ABSTRACT

This chapter examines part of the broad question: "How compelling is the evidence for the effectiveness of e-Learning in the post-16 sector? It concentrates, largely from a UK perspective, on higher education and on policy issues. In the first section the UK Higher Education Funding Council for England (HEFCE) e-Learning strategy is outlined and previous, partial reviews of e-Learning in higher education are examined. The evidence on the effectiveness of e-Learning in higher education is presented using Kirkpatrick's (1998) levels of evaluation, under the following questions: What are the learners' reactions to e-Learning? What is the student experience of e-Learning? What is the quality of the learning? Does e-Learning in higher education alter the behaviour of the learner? What is the impact of e-Learning on the organisation. In the final section recommendations for policy and future research are outlined.

INTRODUCTION

This chapter is very closely based on part of an unpublished monograph, prepared largely by Julie Coultas, for Eduserv under the title "How compelling is the evidence for the effectiveness of e-Learning in the post-16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". The chapter has a narrower scope than the monograph and concentrates, largely from a UK perspective, on higher education and outlines policy issues and further research.

The original monograph was informed by a number of seminars with experts who pointed us towards relevant literature. They emphasised that E-learning is a dynamic concept 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 in the original monograph but not included here.

Definitions were identified as containing three components; skills, computer technology and style of learning. Key factors in effective 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. In the end we adopted the following definition of e-learning:

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.

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.

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 now 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. This has a number of repercussions for an ITS perspective on the field.

In the first section of the chapter, on Higher Education, the HEFCE e-Learning strategy is outlined and previous, partial reviews of e-Learning in higher education are examined. 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

The Conlusions section looks at policy and research implications.

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)

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 Evidence for Policy and Practice Information and Co-ordinating Centre's (EPPI) 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 conferencing (SAC) 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 the 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

HOW COMPELLING IS THE EVIDENCE FOR THE EFFECTIVENESS OF E-LEARNING IN HIGHER EDUCATION?

What are the learners' reactions to e-Learning? What is the student experience of e-Learning?

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.

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.

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.

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.

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.

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 & 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.

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 exploit the resources available.

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 as follows:

> A construct that is used to explain the initiation, direction, intensity, and persistence of an individual's behavior in a particular situation
> (see e.g., Byrnes, 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 (Byrnes, 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, Riffel 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 (ELP) 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-authentic". 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).

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).

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 the 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.

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 enrolments 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.

CONCLUSIONS AND RECOMMENDATIONS

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. We note that e-learning has enabled a greater use of formative assessment, which in its turn has improved learners performance.

Some of the factors affecting the quality of the learning of students, detailed in this chapter, 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.

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:

- 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
- 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.
The issues as they stand at the end of the review in the previous section can be summarised as follows:

- "e-learning" has evolved into “learning in technology-rich environments”: how these environments are resourced and managed is key, and so a driver in the post-16 New Build.
- 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.
- 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
- Research needs to look at the transformational nature of e-learning and how it affects the process and "discourses of learning";
- New measures of effectiveness are needed as Key Performance Indicators tend to map to traditional outcome measures;
- 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.
- 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?

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 the original review we 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.

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. 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. The diversity of approaches to the collection of evidence for the effectiveness of e-Learning is considerable and needs to be brought together in a 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. 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 from a user perspective e.g. age and gender. Also much of the ground of e-learning is being shifted by the rise of social media. So much so that the HEA when reviewing University e-learning use identified the rise of "Hidden Learning Environments" as the practical use of e-learning tools was effectively under the institutional radar.
- 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 and our focus was on higher education *per se* 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?

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KEY TERMS & DEFINITIONS

Assessment is the mechanism by which providers of educational experiences determine the degree to which the consumers of those experiences have understood the material and acquired the skills.

Blended learning is the combined use of both e-learning and non-technology-enhanced learning methodologies.

Collaboration is a methodology for learning that involves two or more learners working together to achieve understanding or master skills.

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.

Kirkpatrick's (1998) "levels" is a methodology for evaluating e-Learning under hierarchical general questions:

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?
3. How does e-Learning alter the behaviour of the learner?
4. What is the impact of e-Learning on the organisation

Learning style is a predisposition to approach a new learning task in a particular manner, for instance in terms of the order in which the material is understood, or in terms of the particular activities undertaken to support learning, or in terms of a particular focus or perspective.

Motivation is the reason why a learner expends effort on the learning process and is a conjunction of factors around her values, expectations and feelings (following Pintrich, 2003).